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Department of
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Forest Service

Stanislaus
National
Forest

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Paper Reforestation Project

Draft Environmental Impact Statement

M0990-43

PAPER REFORESTATION AND RESOURCE RECOVERY ENVIRONMENTAL IMPACT STATEMENT
#M0990-43

Mi-Wok Ranger District
Stanislaus National Forest
Tuolumne County, California

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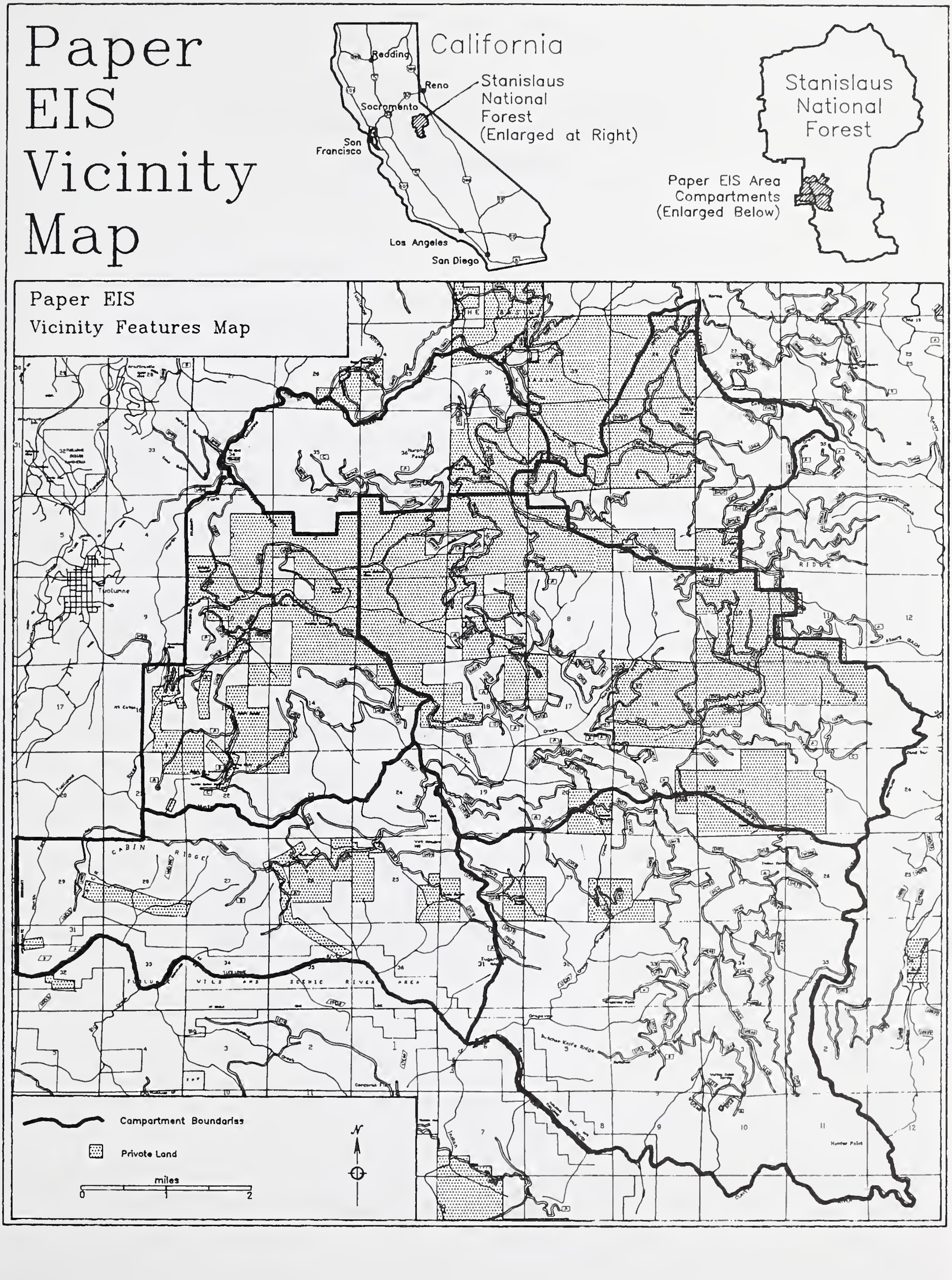
Abstract: This is a DRAFT ENVIRONMENTAL IMPACT STATEMENT that addresses reforestation and resource recovery in the Paper Fire area of the Stanislaus Complex Fire within the Mi-Wok Ranger District. Five alternatives for reforesting and managing vegetation are described and analyzed. The alternatives are: 1) Maintain and establish conifer forest following LMP standards, using aerial and ground applications of herbicide; 2) maintain and establish a conifer forest using aerial and ground applications of herbicides, while re-defining critical deer winter range in response to new data from telemetry studies; 3) maintain and establish a conifer forest using only ground applications of herbicides, while re-defining critical deer winter range in response to new data from telemetry studies; 4) maintain conifers and control competing vegetation on already planted areas without herbicides; 5) no action. All of the alternatives comply with the standards and guidelines, and comply with the land use allocation direction set forth in the Stanislaus National Forest Land and Resource Management Plan, as Amended.

Note to Reviewers: Reviewers should provide the Forest Service with their comments during the review period for the Draft Environmental Impact Statement. This will enable the Forest Service to analyze and respond to the comments at one time and to use information acquired in the preparation of the Final Environmental Impact Statement, thus avoiding undue delay in the decision-making process. Reviewers have an obligation to structure their participation in the National Environmental Policy Act process so that it is meaningful and alerts the agency to the reviewers' position and contentions. Environmental objections that could be raised at the Draft stage may be waived if not raised until after completion of the Final Environmental Impact Statement. Comments on the Draft Environmental Impact Statement should be specific and should address the adequacy of the statement and merits of the alternatives discussed (40 CFR 1503.3).



Paper EIS Vicinity Map
California
Redding
Reno
Sacramento
San Francisco
Los Angeles
San Diego
Stanislaus National Forest (Enlarged at Right)
Stanislaus National Forest
Paper EIS Area Compartments (Enlarged Below)
Paper EIS Vicinity Features Map
Tuolumne
CABIN RIDGE
TUOLUMNE WILD AND SCENIC RIVER AREA
Butcher Knife Ridge
Compartment Boundaries
Private Land
miles
0
1
2
N

PAPER ENVIRONMENTAL IMPACT STATEMENT

TABLE OF CONTENTS

I. PURPOSE AND NEED FOR ACTION

A. Introduction

In 1987, one of the largest wildland fires ever recorded in the history of California burned 147,095 acres of the Stanislaus National Forest in the central Sierra Nevada. Called the Stanislaus Complex Burn, the firestorm affected valuable timberland and watershed across a 25 mile front on the Mi-Wok and Groveland Ranger Districts. Within the Mi-Wok district, the fire burned 37,080 acres of National Forest and private land, leaving few green trees. Of that amount, a total 28,260 acres of National Forest land burned, including 11,750 acres suitable for reforestation.

Following the fire, salvaging of the dead sawtimber occurred over much of the area. Removal of most of the smaller trees occurred during the subsequent years, ending in the summer of 1993. By late winter 1994, all of the areas capable of being prepared for planting mechanically will be treated and planted.

The proposal to reforest the burned area responds to the requirement of National Forest Management Act of 1976 (NFMA) that the Forest Service promptly reforest areas that have been deforested (16 USC 1604 (d)). It also states "It is the policy of Congress that all forested lands in the National Forest System shall be maintained in appropriate forest cover with species of trees, degree of stocking, rate of growth, and conditions of stand designed to secure the maximum benefits of multiple use sustained yield management in accordance with the land management plan." (16 USC 1604 (d)(1)).

The fire severely reduced the Mi-Wok Ranger District's ability to meet its long and short-term multiple use objectives, as mentioned above in the NFMA and as outlined in the Stanislaus National Forest's Land and Resource Management Plan (LMP). These objectives include the enhancement of wildlife habitat, the maintenance of soil productivity, timber production, protection and enhancement of scenic values and outdoor recreation opportunities, and the maintenance of watershed stability.

B. Purpose and Need

The 147,095 acre Stanislaus Complex Fire of 1987 resulted in large areas of fire-killed trees on the Mi-Wok Ranger District. Since then, portions of the area on the District have been replanted with conifer seedlings. However, the conifer seedlings are experiencing high mortality and reduced growth rates due to the high densities of competing vegetation, such as bearclover, manzanita and other shrub and/or grass species. On sites where reforestation has not yet occurred, competing vegetation greatly exceeds the thresholds beyond which conifer seedlings can coexist with associated competing vegetation and still meet LMP stocking and growth standards. As a result, post-fire emergency actions to stabilize the soil have resulted in high, continuous fuel loading which threatens the destruction of reforestation efforts due to wildfire occurrence.

The primary purpose of the proposed project is to provide for conifer reforestation and resource recovery of timber harvest units on 11,750 acres of capable, available and suitable (CAS) acres burned in 1987. This would be achieved by creating favorable conditions for conifer planting, survival and growth to insure that young conifer seedlings grow at a rate that achieves the adopted growth standards by using vegetation management practices.

Competing vegetation needs to be reduced to less than 20 percent crown cover around conifers for a period of two to three years following planting, or, in areas where seedlings were planted in past

years, within two to three years of initial treatment (McDonald and Fiddler, 1989). Experience and current seedling mortality rates indicate that without effective control of competing vegetation, there is a high probability of extensive plantation failure on these acres. To protect the reforested area, fuel reduction treatments are needed on up to 1,127 acres within the project area and on an additional 2,205 acres adjacent to the project area. The objective of fuel reduction is to reduce wildfire risks in order to protect the reforestation investment (LMP, pp. IV-39-49, Management Practice for Fuels Management, 4-B, pp. IV-49).

The 1987 fire topkilled most of the oak trees in the project area. A secondary purpose of this project is to maintain oak (*Quercus spp.*) trees to meet the management guidelines established by current Forest direction for wildlife habitat (mainly deer).

C. Description of the Proposed Project

The Mi-Wok Ranger District proposes to maintain and establish a conifer forest on up to 11,750 acres. The proposal includes the use of aerial and ground applications of herbicides, which are essential to efficiently and effectively control competing vegetation.

The project is estimated to take 4 years to complete. Project activities would consist of combinations of fuels reduction, site preparation, planting, release and interplanting treatments. Activities include the release needs of the areas that were mechanically treated and planted, and the reforestation needs on the remaining, untreated slopes.

The proposal begins in March, 1994, with release of existing plantings and site preparation of a portion of the unplanted area. Aerial application of granular hexazinone (Pronone 10G) would be used to accomplish this. The use of this product, a granular formulation, essentially eliminates any concern over drift. The issues revolving around drift were generated with respect to aerial application of liquid formulations. The active ingredient of this herbicide, carried on the surface of clay granules, does not have the ability to remain suspended in the air mass due to it's much higher mass. Additionally, the reduction of particle size, upon release from the aircraft, due to evaporation, is not an issue with a dry particle. Ground, backpack, applications would be used to avoid clusters of hexazinone-sensitive conifers and to treat the outer portion of the 100 foot aerial application buffer strip. In areas containing sandy-type soils, ground applications of glyphosate or a mixture of glyphosate-triclopyr would be used. For a detailed explanation of the treatment activities, refer to the "Alternatives" section of Chapter II.

All vegetation treatments would be tailored to provide for the successful attainment of existing wildlife habitat objectives. Specifically, hardwoods and browse levels identified within the Forest Plan would be incorporated within project objectives.

Up to 7,970 acres would be planted over the span of the project. The additional 3,780 acres deeptilled and planted would require interplanting to provide tree species diversity and to improve stocking levels. Both planting and interplanting are also important aspects of the project as they restore the project area's biological diversity, which was severely impacted by the Stanislaus Complex Fire. Left to natural regeneration, reforestation would require decades to reach the desired biological diversity for the project area.

D. Description of the Project Area

Successful reforestation is accomplished by creating favorable conditions for conifer planting, survival and growth. This includes vegetation management practices to insure conifer seedling growth

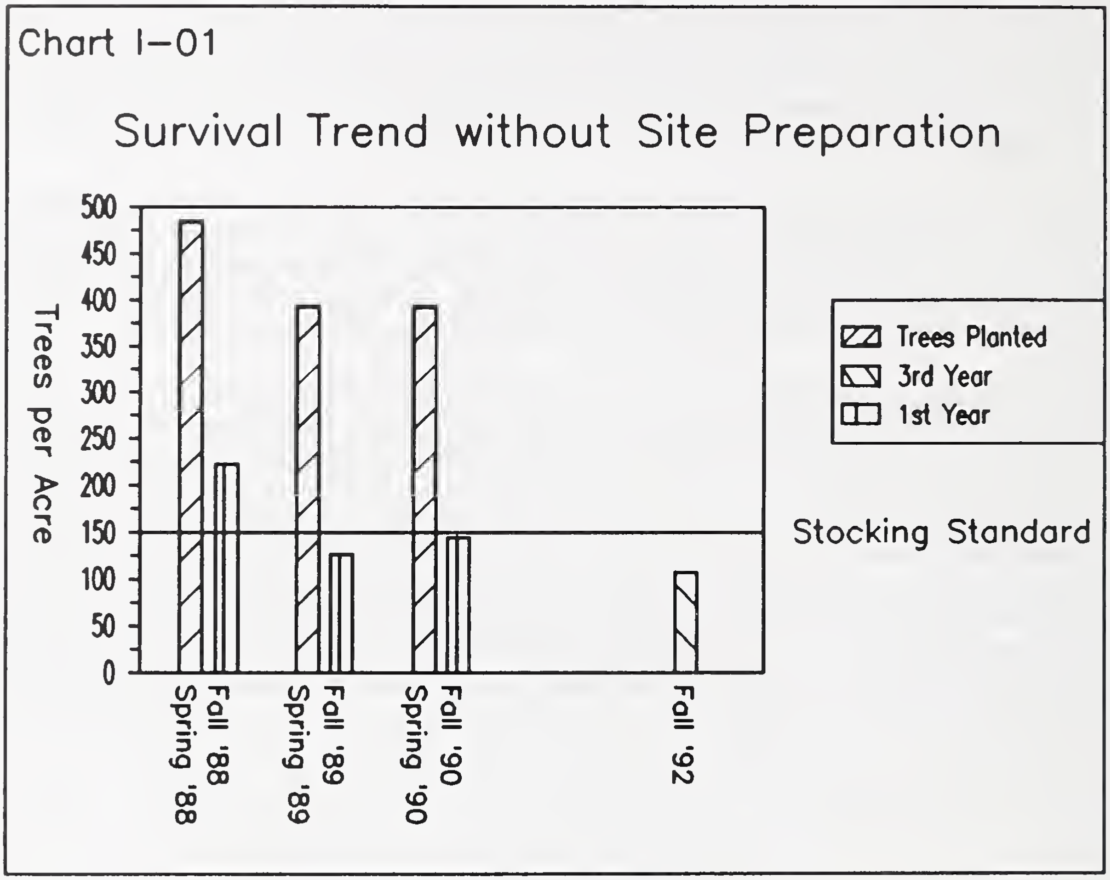
at rates that would achieve the adopted Forest Plan growth standards. As previously state, reaching this objective requires a reduction of competing vegetation to less than 20 percent crown cover for a period of two to three years following planting.

High densities of bear-clover, manzanita, other sprouting shrub species and/or grass pose the greatest threats to successful conifer reestablishment by competing with conifers for moisture and nutrients. Bearclover is especially competitive with conifer seedlings due to its deep root system. It typically grows in a dense mat which prevents other vegetation from becoming established. The present vegetative environment, sprouting plants and/or steep slopes, precludes the use of hand and/or mechanical strategies. This reality is further compounded by the lack of organizational time and personnel to responsibly accomplish hand and mechanical treatments over large acreages.

Six growing seasons have passed since the 1987 firestorm. On sites where reforestation has not yet begun, competing vegetation greatly exceeds the thresholds beyond which conifer seedlings can coexist with associated plants and still meet LMP stocking and growth standards. On sites that have been mechanically prepared and planted, competing vegetation rapidly reoccupied the area and has caused mortality and reduced growth of the surviving seedlings.

This mortality and reduced growth rate are illustrated by the Paper Cabin project, in which no site preparation or release methods were used. The Paper Cabin project is located within the burn area, adjacent to this proposed project. In spring, 1988, the District planted 26 acres with 480 trees per acre that had been donated by a member of the public. This area had been intensively burned and had little competing vegetation at the time of planting. In spring, 1989, an additional 869 acres were planted at 390 trees per acre. By fall, only 125 seedlings per acre survived at an overall 68 percent failure rate. This failure is due to competing vegetation. The project area was interplanted in spring, 1990, at a maximum of 390 trees per acre. A third year survival exam on the entire 895 acres showed an overall average of 110 trees per acre survived, roughly 27 percent below the regional stocking standard of 150 trees per acre. Data indicated that densities of competing vegetation ranged from 35 to 95 percent ground cover. The chart on the following page illustrates the survival trend in the area.

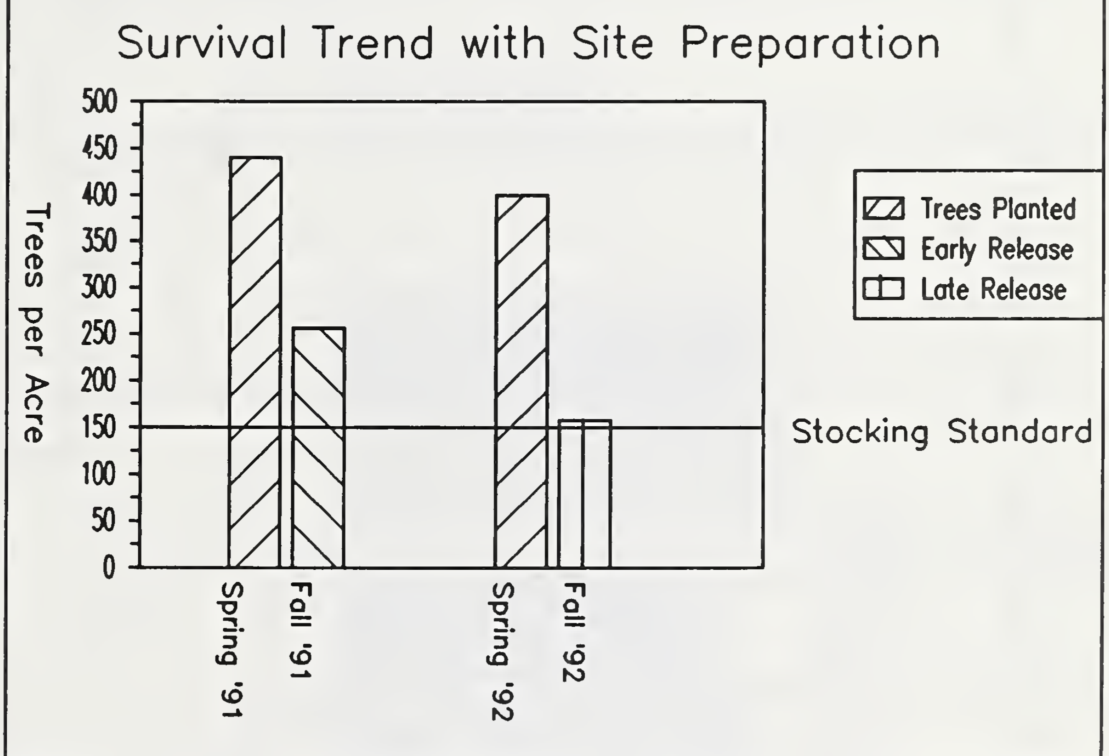
The following chart illustrates the survival trend for conifer seedlings planted in the Paper Cabin project without site preparation. The primary reason for seedling mortality is the associated, competing, vegetation.



The trend illustrated in the previous chart continues in areas within this proposed project, where survival and growth rates of planted areas have plummeted due to competing vegetation. In 1990, site preparation using deeptilling started on 1,145 acres. Those areas were planted in spring, 1991, at 440 trees per acre and immediately hand-released. In 1991, an additional 1,159 acres were site prepped using deeptilling, followed by planting in spring, 1992, at 400 trees per acre. Release was delayed until late summer due to budget restraints. By fall, 1992, the survival rate of late-released conifers had already dropped to just above the regional stocking standard. Although immediately hand released conifers experienced more initial success, conifer mortality in those areas had already exceeded 40 percent by the end of the first year. Stocking had fallen short of optimal and is predicted to drop significantly below regional standards.

The following chart illustrates this survival trend for conifers planted within the project area, using non-herbicide site preparation and release methods:

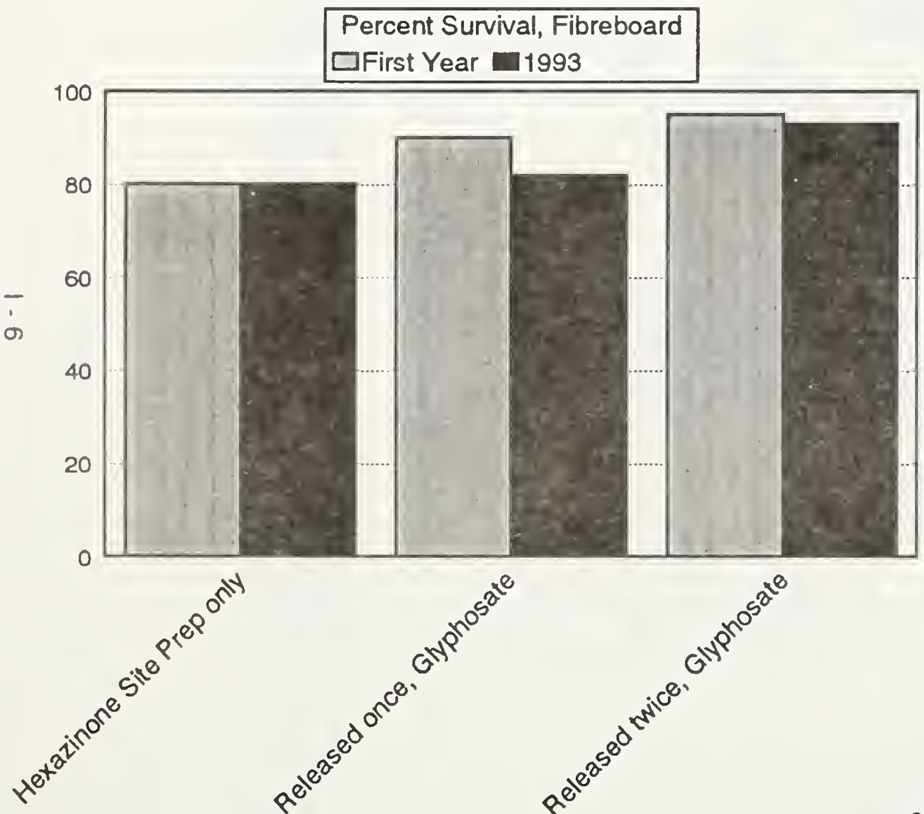
Chart I–02

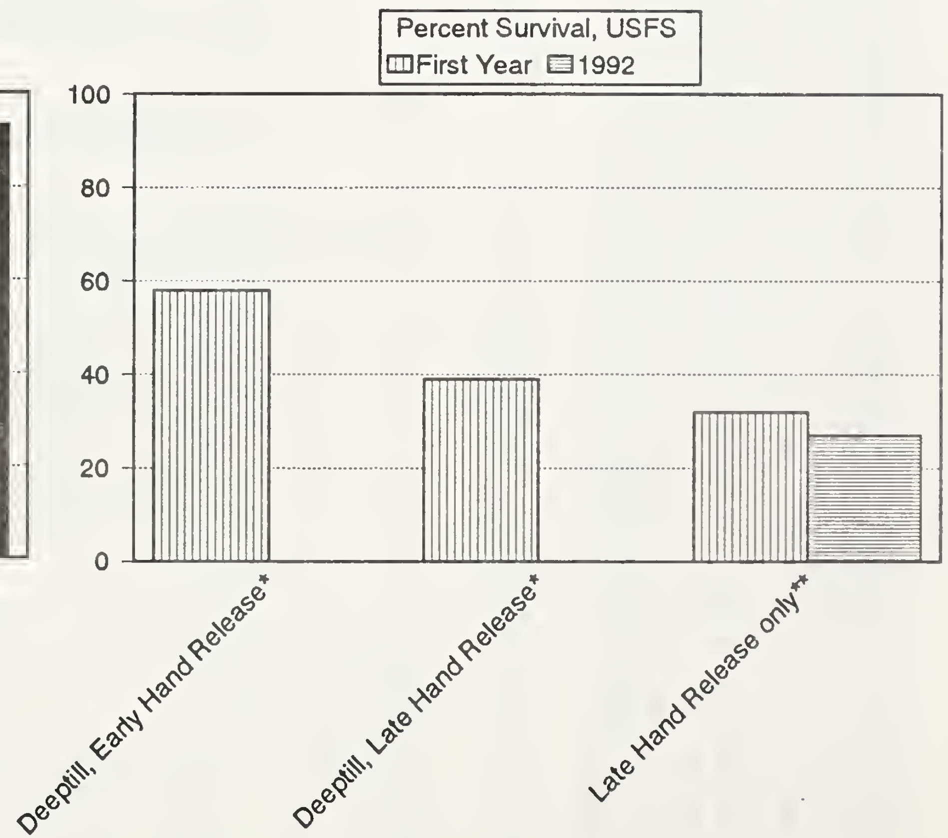


This year, 1,483 acres were planted following deeptilling. They have yet to be released. Chart I-3 illustrates the high survival rates possible with effective control of competing vegetation. Survival with the marginal reduction of competing vegetation achieved through handgrubbing is also shown.

Chart I-3, Survival within the Stanislaus Burn

Survival with Herbicide Treatments versus Mechanical and Hand Treatments





* No data available for 1993. **Survival data includes interplanted trees- actual survival is lower.
All areas treated with herbicide had an initial hexazinone site preparation. Data on herbicide treatments taken from Fibreboard Corporation lands within the Stanislaus burn. Data on mechanical and hand treatments taken from National Forest lands within the Stanislaus Burn.

Experience and current seedling mortality trends indicate that without timely, effective control of competing vegetation, there is a high probability of extensive plantation failure and loss of potential tree growth on the project area. Likewise, there is little hope that additional establishment of conifers would occur without effectively reducing competition levels.

E. Location

The project area lies roughly north of the Tuolumne Wild and Scenic River canyon area and northwest of the Clavey River canyon, east of the north fork of the Tuolumne River canyon and south of Basin and Cottonwood Creeks. The 11,750 acres are within the following six compartments: Matsen, Cottonwood, Paper Cabin, Walton Cabin, Bear Springs and Murphy. (Refer to vicinity map and compartments maps, pp. I-10 to I-16).

F. Decision Needed

The Forest Supervisor is responsible for making the decision describing how the project objectives would be met.

A decision is needed to determine the nature of the future treatments in the planted areas and in the areas not yet prepared for planting.

G. Issues

In response to the changes caused by the 1987 fire and the proposal to reforest, these primary issues were identified:

1. Human health and herbicide use, and
2. Mule deer winter range needs

Based on these two issues and the list of issues that follows, the alternatives described in Chapter II were developed. The issues are listed by resource.

Air Quality

Issue 1: The proposed project is within the Mountain Counties Air Basin (MCAB) of California, part of a federal Class 2 airshed. Two federal Class 1 airsheds exist within 12 miles easterly and northeasterly of the project: the Emigrant Wilderness and Yosemite National Park.

What effects would broadcast burning have on air quality within these airsheds?

Economics

Issue 2: Reforestation treatments require the investment of hundreds of dollars per acre. What options are available to reduce the cost of the investments?

Issue 3: Tourism provides important economic benefits to the County. How does this proposal affect tourism?

Fire/fuels

Issue 4: Given that wildfire is likely to reoccur in this area, how would reforestation activities provide for protecting the new forests?

Heritage Resources

Issue 5: The area burned includes areas that may be eligible for the National Register of Historic Places. How would this project affect these locations? Additionally, how would Mewuk values and traditions be affected?

Human Health and Safety

Issue 6: How is human health affected by the use of herbicides during reforestation activities?

Range

Issue 7: Portions of the proposed treatment area are utilized by cattle. How would they be affected by vegetation management associated with reforestation?

Recreation/Scenic

Issue 8: The project area is used for limited recreational activities. How would this proposal affect this use?

Soil

Issue 9: Maintaining long term soil productivity is a NFMA requirement. How would reforestation activities affect these factors?

Vegetation/Sensitive Plants/Riparian

Issue 10: Herbicides would affect the existing composition of vegetation. How does the project provide for a diversity of plant species. Also, how would sensitive plants and riparian areas be affected?

Water Quality

Issue 11: How would herbicide use affect water quality?

Issue 12: Prescribed fire reduces the protective cover offered by organic material on the soil surface, resulting in an increased chance of stream sedimentation. Would this proposal contribute to stream sedimentation?

Wildlife/Fisheries

Issue 13: How would herbicide use affect the health of wildlife that use the project area for food and cover?

Issue 14: How would the project incorporate new information, from the State's telemetry research, on deer use patterns?

H. Objectives

The project goal is the re-establishment of a conifer forest using environmentally sound and economically efficient techniques. The following objectives strive to achieve that goal and incorporate the concerns discussed in the previous section.

1. Meet timber objectives as described in the LMP (Appendix D, pp. 4 and 5) while maintaining, or enhancing, plant biodiversity and visual quality.

2. Meet deer winter herd habitat needs by managing habitat.

3. Meet other non-game and game wildlife habitat needs by fostering the recovery of diverse forest structure composition within the reforestation project area.

4. Meet water quality standards by complying with applicable California state water quality, and anti-degradation policies.

5. Encourage riparian species, such as willow, alder and dogwood.

6. Maintain soil productivity by utilizing treatment methods that will meet Soil Quality Standards (LMP, Chapter IV, pp. 75-78; Appendix J):

7. Utilize cost and time efficient treatments whenever feasible. Also, create conditions to provide for timber volume yields as predicted by the LMP.

8. Enhance scenic values of the landscape by maintaining and fostering vegetative diversity.

9. Reduce fuel concentrations and establish fuel-breaks to meet objectives outlines in the Forest Plan (LMP, pp. IV-43 and 44).

10. Reestablish a conifer forest using environmentally sound and economically efficient vegetation management techniques that comply to the VMFEIS.

I. Tiering to Related Documents

The Stanislaus National Forest Final Environmental Impact Statement (SNFFEIS) and the Stanislaus National Forest Land and Resource Management Plan (LMP), October 28, 1991, provide direction for management activities on the Stanislaus National Forest. This analysis tiers to the SNFFEIS and incorporates the contents of the LMP.

The Final Environmental Impact Statement for Vegetation Management for Reforestation and Record of Decision (VMFEIS), February 27, 1989, establishes a broad policy to control competing vegetation in the Pacific Southwest Region. This analysis tiers to and incorporates the contents of the VMFEIS.

Copies of each document are available for public review at the Forest Supervisors Office, 19777 Greenley Road, Sonora, California, or at the Mi-Wok Ranger District, Highway 108, Mi-Wuk Village, California.

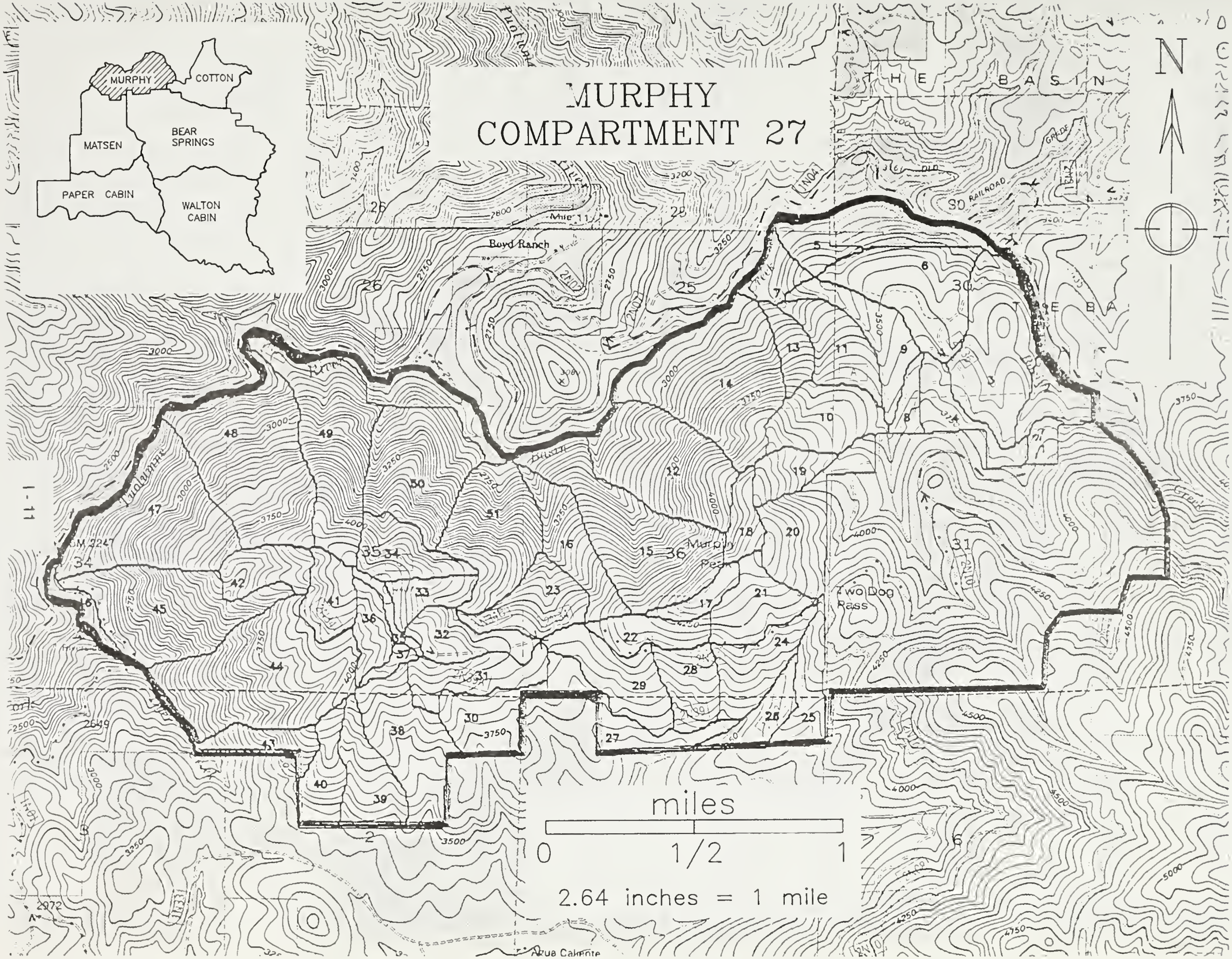
J. Public Involvement and Scoping

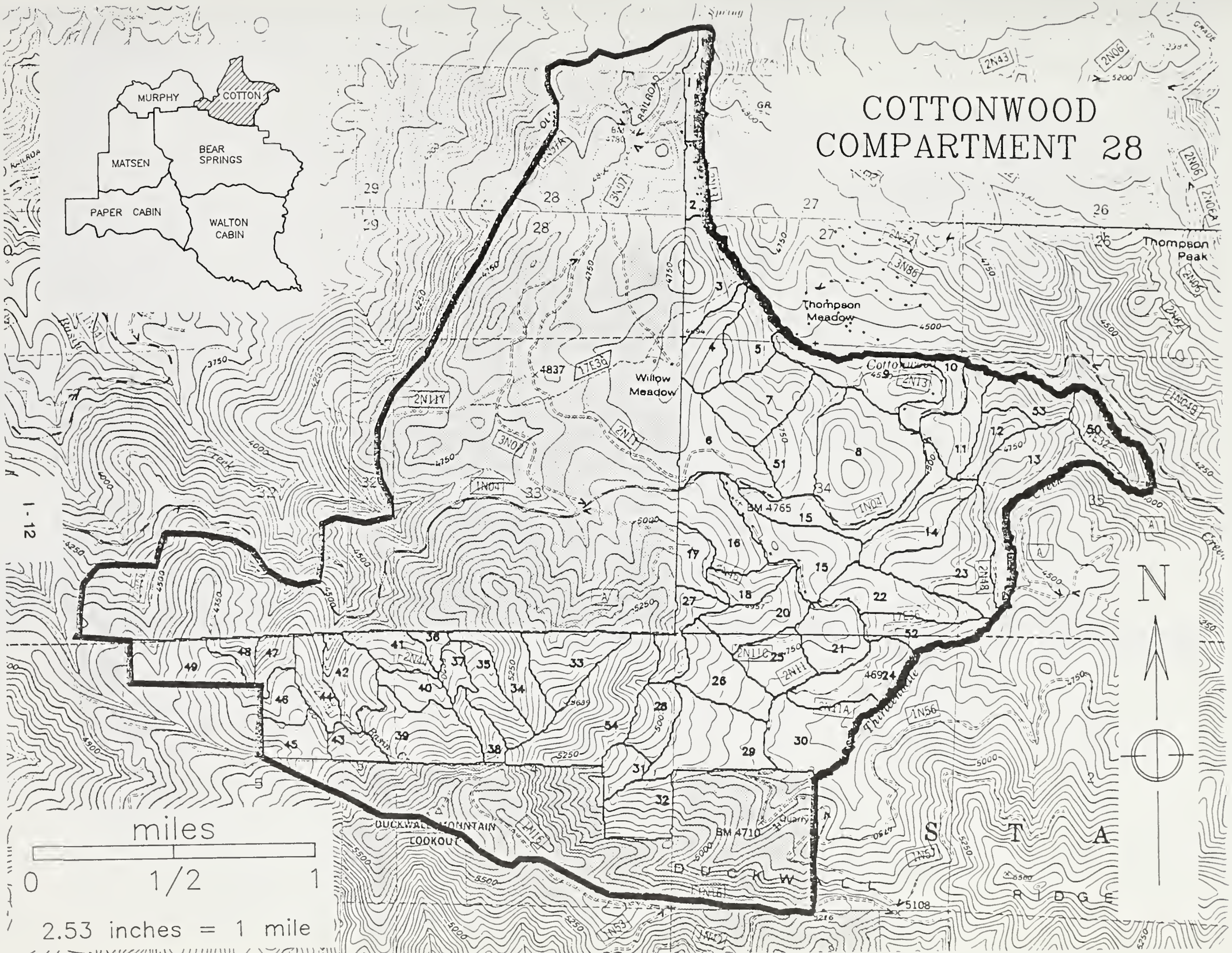
Public scoping occurred via mail, news coverage, and public meetings. Landowners, interested public, Native American Tribes, County Supervisors, and the Department of Fish and Game received letters requesting their input to the environmental analysis process. Meetings were held between the District Silviculturist and local Sierra Club representatives. TUCARE (Tuolumne County Alliance for Resources and Environment), a local resource group, sponsored a panel discussion between regional-level Forest Service representatives, the county and interested publics. The local newspapers have published articles on project-related activities, reforestation progress, and various meetings. The scoping process is discussed in more detail in Appendix 6.

K. Pertinent Laws and Regulations

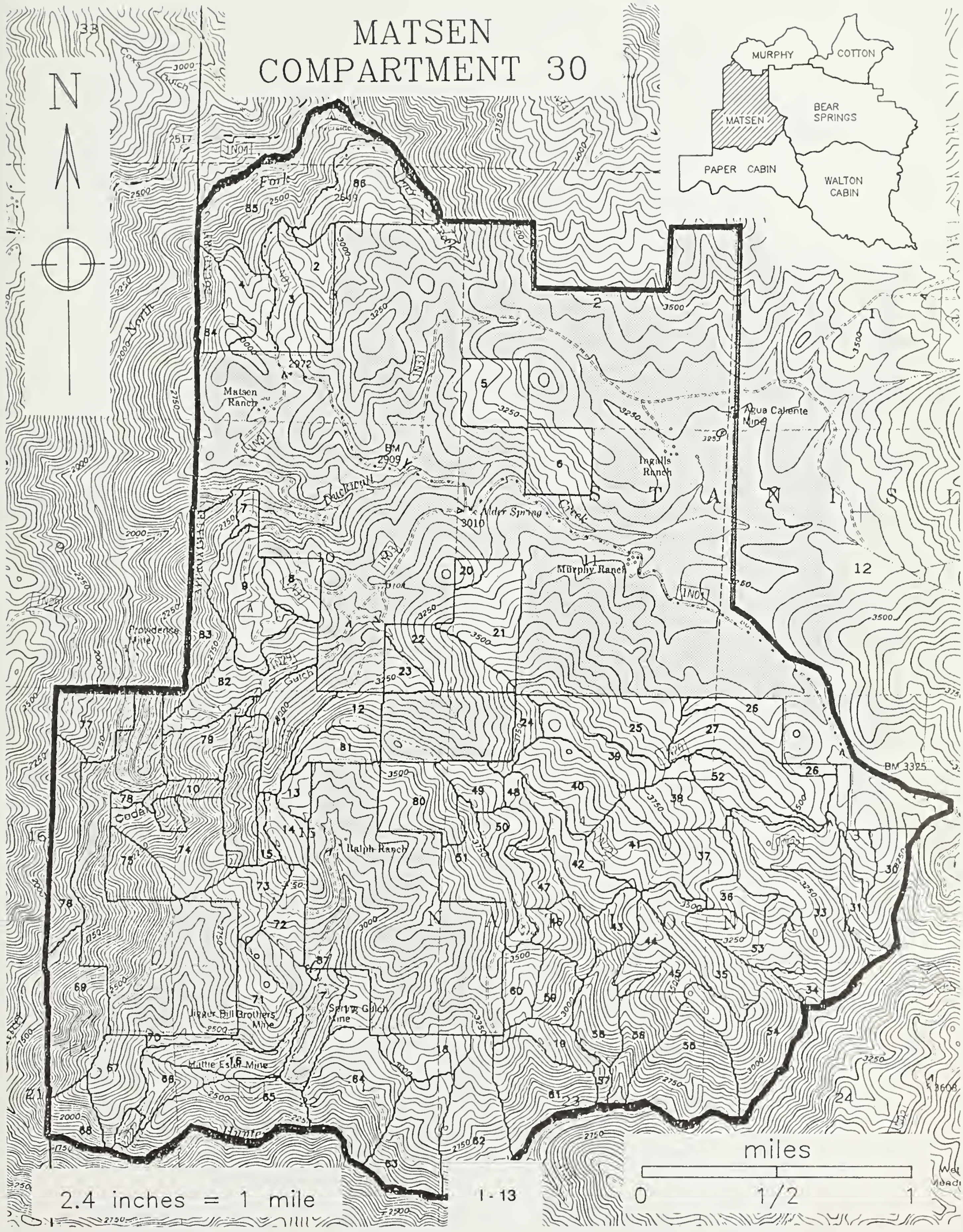
The following policies, laws, regulations and appropriate amendments are pertinent to the proposed project:

1. Forest Service Manual (FSM 1013.4)
2. Multiple Use Sustained Yield Act of 1960
3. Forest and Rangeland Renewable Resources Planning Act of 1974
4. National Forest Management Act of 1976
5. Organic Administrative Act of June, 1897
6. Endangered Species Act of 1973
7. Federal Clean Water Act of 1972
8. National Environmental Policy Act of 1969

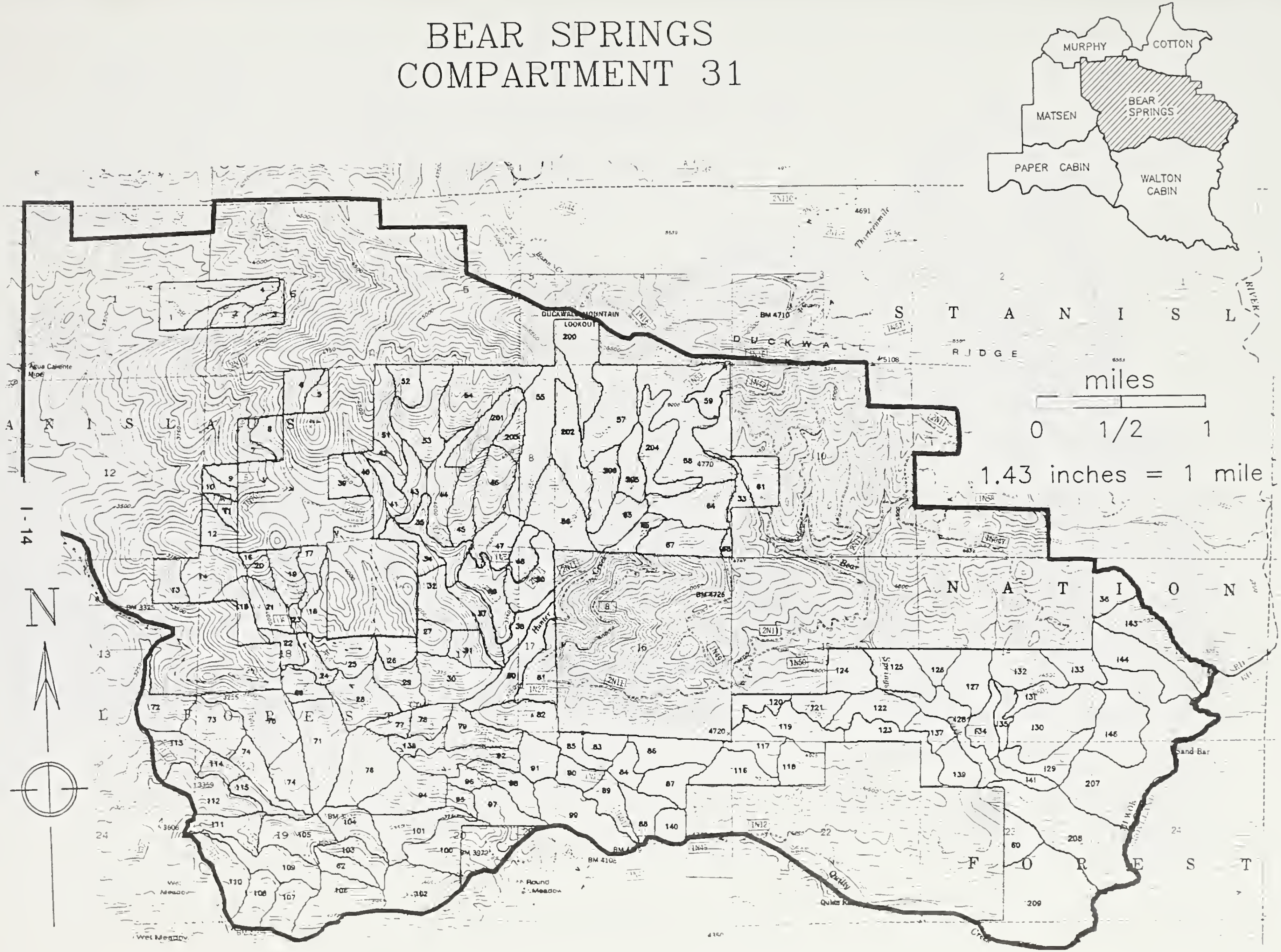

MURPHY
COMPARTMENT 27
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN
N
THE BASIN
miles
0
1/2
1
2.64 inches = 1 mile
Boyd Ranch
Two Dog Pass
Murphy Peak

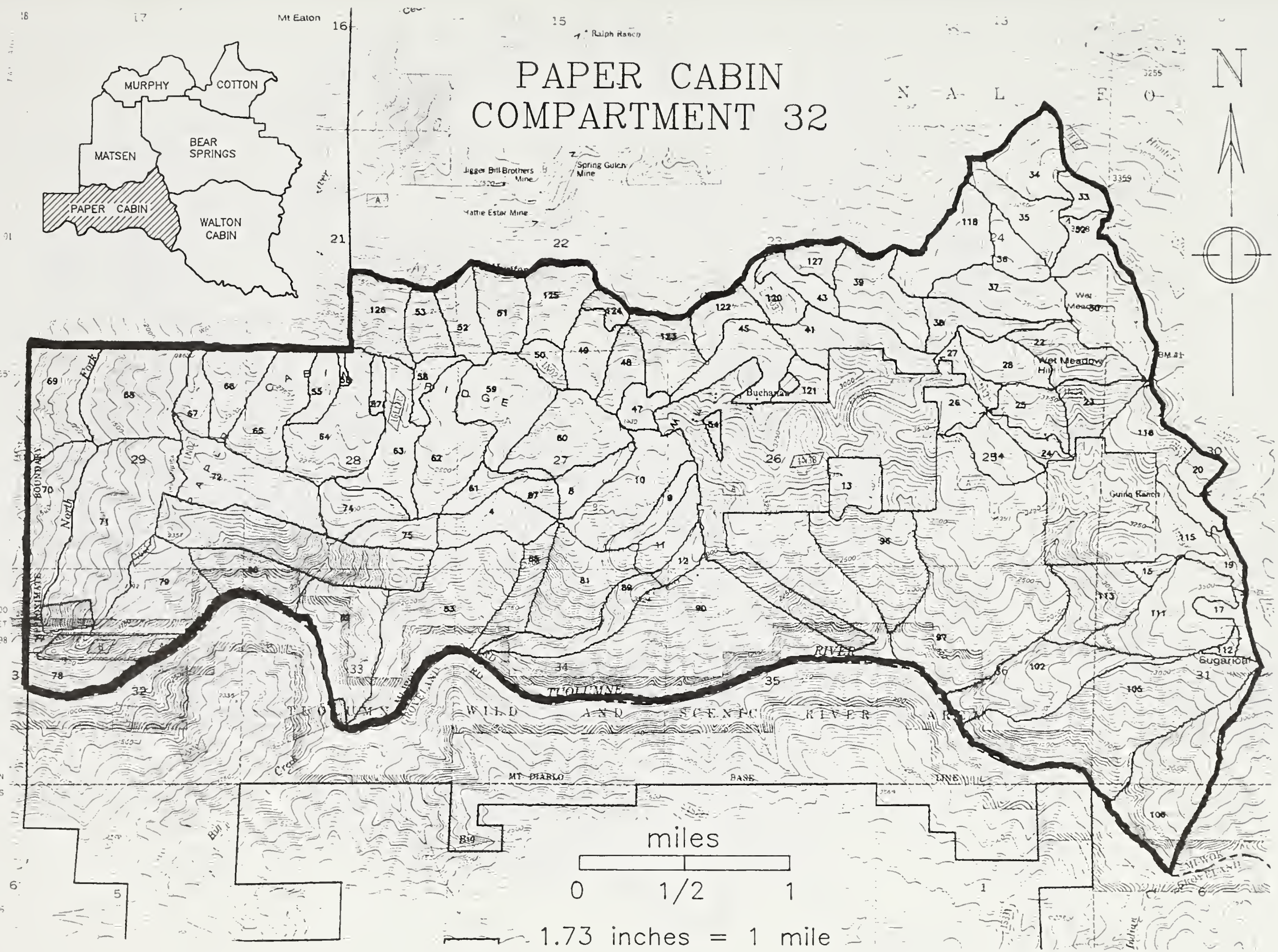


COTTONWOOD
COMPARTMENT 28
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN
Thompson Peak
Thompson Meadow
Willow Meadow
BM 4765
BM 4710
DUCKWALL MOUNTAIN LOOKOUT
DUCKWALL
STATE RIDGE
N
miles
0
1/2
1
2.53 inches = 1 mile

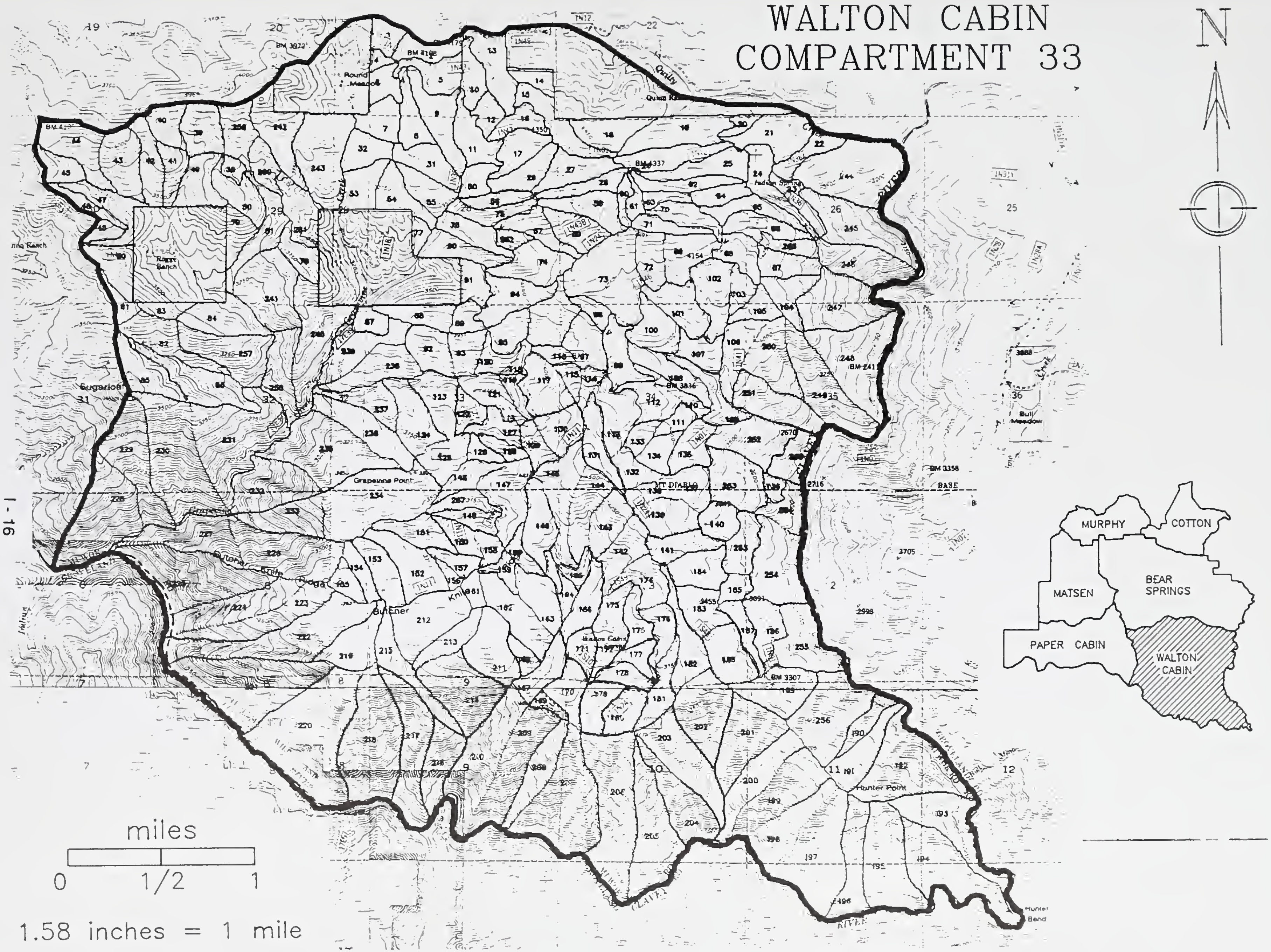

MATSEN
COMPARTMENT 30
N
MURPHY
COTTON
BEAR SPRINGS
MATSEN
PAPER CABIN
WALTON CABIN
Matsen Ranch
Agua Caliente Mine
Ingalls Ranch
Murphy Ranch
Alder Spring
Providence Mine
Ralph Ranch
Jigger Bill Brothers Mine
Spring Gulch Mine
Hattie Estill Mine
2.4 inches = 1 mile
miles
0
1/2
1

BEAR SPRINGS
COMPARTMENT 31




PAPER CABIN
COMPARTMENT 32
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN
Mt Eaton
Ralph Ranch
Jigger Bill Brothers Mine
Spring Gulch Mine
Hattie Estar Mine
Buchanan
Wet Meadow Hill
Guido Ranch
Sugarloaf
TUOLUMNE RIVER
WILD AND SCENIC RIVER AREA
MT. DIABLO BASE LINE
miles
0
1/2
1
1.73 inches = 1 mile

WALTON CABIN COMPARTMENT 33



II. ALTERNATIVES INCLUDING PROPOSED ACTION

This chapter describes the alternatives considered to maintain and establish a conifer forest on burned acres within the Stanislaus Complex Area on the Mi-Wok Ranger District. This chapter includes: Alternatives, including the preferred alternative, a no action alternative and two alternatives that were considered but eliminated from detailed analysis; management requirements and mitigations, according to each alternative; and an alternatives comparison summary chart that illustrates how each alternative meets the project objectives.

A. Alternatives

These alternatives were developed by the interdisciplinary team (IDT) to address the issues identified during project scoping. All of the alternatives are consistent with the Standards and Guidelines of the Stanislaus National Forest Land and Resource Management Plan (LMP).

Each alternative contains combinations of actions which respond to a specific set of circumstances at each site, with particular attention to the existing vegetation, physical factors and resource objectives. These actions include a series of treatments designed to reach specific reforestation objectives.

Treatments occur in two distinct phases: Site preparation and release. Site preparation is the removal of unwanted vegetation to prepare an area for planting. The treatments would include herbicide or manual methods, depending on the alternative. Broadcast burning would be conducted in some areas to reduce fuels or brush concentrations too heavy to plant in. Release is the freeing of a tree or group of trees from competition from other vegetation for soil moisture, light and nutrients by cutting or otherwise eliminating the vegetation that is overtopping or closely surrounding the trees. Treatments include herbicide or manual methods, depending on the alternative.

The alternatives are (1) maintain and establish a conifer forest following LMP standards, using aerial and ground applications of herbicide; (2) maintain and establish a conifer forest using aerial and ground applications of herbicides while incorporating the results of recent deer winter range use patterns; (3) maintain and establish a conifer forest without aerial herbicide application while incorporating the results of recent deer winter range use patterns; (4) maintain conifers and control competing vegetation on existing deeptilled and planted areas without herbicides; (5) no action.

Two additional alternatives were considered and are discussed in this chapter. They were eliminated from detailed study. They are: Extend the conifer reestablishment period from 4 years to 30 years; and manage for long-term soil productivity by emphasizing oak management on specific stands.

Each alternative responds to varying sets of issues in efforts to reach project objectives. **Alternative 2 is the agency preferred alternative.** Alternatives 2-5 were developed to respond more specifically to the issues identified in Chapter 1 on pages I-7 to I-9.

In summary, Alternative 1 follows Forest Plan standards for wildlife and forest establishment. Of the five alternatives, it has the greatest timber yield. (Refer to Appendix 3, "Expected Timber Yields, Economic Costs and Returns"). Alternative 2 utilizes new information on key deer winter range and targets wildlife objectives. The timber yield in Alternative 2 is less than Alternative 1. The wildlife emphasis in Alternative 3 is identical to Alternative 2, however the project area is reduced due to the elimination of aerial herbicide applications. The result is a lower timber yield than Alternatives 1 and 2. Herbicide applications are eliminated from Alternative 4, which automatically decreases the project to acres already deeptilled and planted. Those planted areas are on slopes less than 35 percent

where mechanical site preparation was possible. It is unfeasible to reforest any of the remaining slopes - all of which are greater than 35 percent - without treating competing vegetation with herbicides. Due to limited area and treatment methods, Alternative 4 would produce even lower timber yields. Alternative 5, the no action alternative, would abandon further planting and release, resulting in the lowest projected timber yields. Neither Alternative 4 nor Alternative 5 contain a wildlife emphasis since so much of the area in both alternatives would return to natural recovery.

Alternative 1: Maintain and establish conifers on 11,750 capable, available and suitable acres following LMP standards using ground and aerial herbicide applications to control competing vegetation.

Alternative 1 would reforest 11,750 acres with an emphasis on LMP resource objectives. Within the project area, 3,780 acres have already been deeptilled and planted. A total of 7,970 acres unsuitable for deeptill would be reforested. In the deeptill areas and areas yet to be reforested, unwanted grasses, forbs and shrubs would be treated with a variety of aerial and ground herbicide applications.

This alternative also manages for oak and critical deer winter range, as per the Forest Plan standards. When available, at least 10 square feet basal area per acre of native oaks (10 sqft/acre of oaks) are retained (LMP IV-176)). The Forest Plan requires that acres subjected to wildfire provide an average of 36 square feet of basal area per acre of oaks in areas identified as critical deer winter range. (LMP, p. IV-177 and Appendix I, Map 2). Critical deer winter range is illustrated in the "Emphasis Map for Alternative 1" on page II-9.

On the following three pages is Table II-1, which shows what treatments are being proposed for each stand:

Table II-1 Treatment Scenarios for Alternatives 1 and 2

Compart ment	Stand #s	Aerial Hex; Ground Gly/ Tri	Aerial Hex; Broad Burn; Grnd Gly/Tri	Broad Burn; Aerial Hex; Grnd Gly/Tri	Grnd Hex; Grnd Gly/Tri	Grnd Gly/Tri Grnd Gly/Tri	Grnd Gly; Grnd Gly/Tri Grnd Gly/Tri
Murphy	8,9,30,31 10,11,16- 29,32-42, 44,48,49, 51 30,31	784				67	61
Cotton wood	17,27,28, 31,39,43, 45,46,49	164					
Matsen	5,6, 15,20-54 21,33,35, 36,45,47, 49 51	976	167				20

Compart ment	Stand #s	Aerial Hex; Ground Gly/ Tri	Aerial Hex; Broad Burn; Grnd Gly/Tri	Broad Burn; Aerial Hex; Grnd Gly/Tri	Grnd Hex; Grnd Gly/Tri	Grnd Gly/Tri Grnd Gly/Tri	Grnd Gly; Grnd Gly/Tri Grnd Gly/Tri
Bear Springs	1-15,17, 20-35,37-48,50-52, 55-57,59, 61,62,65, 68-76, 78,79, 81-92, 94-103, 105-112, 116-121, 123,138, 140	2637					
	3,31,32,38 43,64,77-81,84,87-92,95,101, 105,108, 120-122, 138		504				
	16,18,19, 49					57	
	19,49						41
	46,53,54, 56,58,67			404			
Paper Cabin	12,13,19, 24,25,27, 28,32,33, 36-39,41, 45,47-50, 111,112, 115,116	733					
	47-50			52			
	17,20,22, 23,30					124	
	17,20,22, 23,30						95

Compart ment	Stand #s	Aerial Hex; Ground Gly/ Tri	Aerial Hex; Broad Burn; Grnd Gly/Tri	Broad Burn; Aerial Hex; Grnd Gly/Tri	Grnd Hex; Grnd Gly/Tri	Grnd Gly/Tri Grnd Gly/Tri	Grnd Gly; Grnd Gly/Tri Grnd Gly/Tri
Walton	1,2,5,8-19 26-32,38, 44-51,53- 60,64,68,69 72,74-80, 83-135, 137-185, 202,203, 211-213, 215,219, 222,234- 239,242, 243,250, 251,253, 259-262, 266	4407					
	4,6,7,61, 63,70,						45
	6,7,19,61, 63,70					95	
	21,22, 24,25, 62,65-67, 71-73, 101-103, 105,106,				317		
Grand	Totals	9701	671	456	317	343	262

Alternative 1 would conduct release and site preparation over a span of four years. (See Table II-2, "Acres of Treatment by Year for Alternative 1"). Treatment activities would begin in March, 1994, when acres that have been deeptilled and planted would be released using aerial applications of granular hexazonine (Pronone 10G). At the same time, granular hexazinone would be aerially applied to prepare sites for planting.

Table II-2 **Acres of Treatment by Year for Alternative 1**

Treatment	1994	1995	1996	1997
Aerial Release (hexazinone)	3260			
Aerial Site Prep (hexazinone)	2691	1994	2875	
Ground Release (hexazinone)	177			
Ground Site Prep (hexazinone)	148			
Site Prep (glyphosate)	133	57	72	
Ground Release (glyphosate-triclopyr)	343	6752	2051	2947
Ground Site Prep (glyphosate-triclopyr)	133	57	72	
Site Prep Burning	906	191	30	
Fuel Reduction Burning	209	778	798	420
Plant		2972	2051	2947
Interplant		3780		

Where sensitive plants exist, applications would be modified to avoid populations (see Chapter II, Management Requirements and Mitigations, "Vegetation/Sensitive Plants) by ground applying liquid hexazonine (Velpar L) from backpack sprayers. Site preparation using hexazinone would continue in subsequent project years. Since hexazinone is a root-active herbicide, it would be applied in March to ensure that sufficient rainfall moves the herbicide into the root zone of competing plants. All aerial operations would remain outside the 0.25 mile buffer zone for California Spotted Owl activity centers from March 1 to August 15 to avoid disturbing owl breeding and nesting.

Following release and site preparation treatments, interplanting and planting are scheduled in January and February, when soil temperature and moisture are optimum. Deeptilled areas would be interplanted to fill in places where seedling mortality has occurred. At this time, sugar pine, incense cedar and white fir would be intermixed with existing ponderosa pine and douglas fir. (Since sugar pine, incense cedar and white fir are sensitive to hexazinone, planting these three species would be deferred until the hexazinone has biodegraded). Planting areas yet to be reforested would start in January and February, 1995, with a mix of ponderosa pine, douglas fir, sugar pine, incense cedar and white fir. Up to 30 percent conifer species other than ponderosa pine would be planted. Ponderosa pine, the most abundant conifer at low to middle elevations, would make up the remaining 70 percent.

In areas where hexazinone cannot be used due to sandy soils, the areas would be site prepped twice using a spring hand application of glyphosate (Accord) followed by a summer application of glyphosate-triclopyr (Accord and Garlon 4). After planting, the areas would be released using a tank mix of glyphosate-triclopyr.

Glyphosate would be applied in early April to treat unwanted grasses and forbs. The tank mixture of glyphosate-triclopyr would be applied over the same area to treat missed and/or recovering competing plants, in particular woody-type vegetation. Glyphosate-triclopyr treatments would be scheduled in May of each project year, since these foliar active herbicides are most effective when applied in dry weather to the above ground portion of unwanted vegetation.

In areas treated aerially with granular hexazinone and assigned an Oak 36 emphasis, application would be adjusted to meet the hardwood stocking target. In doing so, browse species for wildlife would be provided for. This will meet Forest Plan guidelines (LMP, p. IV-174).

When ground applications of hexazinone occur, application would avoid the oak root system to provide for maintaining the targeted stocking level. Where glyphosate and triclopyr are used, the hand crew would avoid direct contact with oaks to provide for the desired stocking level.

Alternative 1 would designate 758 acres as 36 sqft/acre of oaks. Refer to Table II-3, "Acres of Treatment by Emphasis in Alternative 1").

Table II-3 **Acres of Treatment by Emphasis In Alternative 1**

TREATMENT	EMPHASIS	ACRES
Aerial Release (hexazinone)	Oak 36	205
Aerial Site Prep (hexazinone)	Oak 36	451
Ground Release (hexazinone)	Oak 36	41
Ground Site Prep (hexazinone)	Oak 36	61
TOTAL	Oak 36	758
Aerial Release (hexazinone)	LMP	3055
Aerial Site Prep (hexazinone)	LMP	7109
Ground Release (hexazinone)	LMP	136
Ground Site Prep (hexazinone)	LMP	87
Ground Site Prep (glyphosate)	LMP	262
Ground Release (glyphosate-triclopyr)	LMP	343
TOTAL	LMP	10,992

Buffer strip widths and location for each stand have been determined by the Project Hydrologist as part of the water quality monitoring plan for this project. The buffer strips are designated by flagging or otherwise indicated prior to herbicide treatment. Buffer zone widths are as follows:

Aerial herbicide application shall be excluded within 100 feet of either side of a "live" stream's high water line. (A live stream is any perennial, intermittent or ephemeral watercourse, or spring area, which has surface water at the time of application). Note: streams not flowing during aerial application of herbicides (a "dry" stream) are not required to have a buffer zone because it is impractical to exclude all minor streams when conducting aerial operations.

Ground application of hexazinone shall be excluded within

- 50 feet of any live stream or spring

- 10 feet of any dry stream or spring

Based on the results of water quality monitoring from the Groveland Conifer Release Project in 1992 and 1993, no additional SMZ buffer strips, other than EPA and State approved herbicide label requirements, shall be required for glyphosate and triclopyr applications in this project.

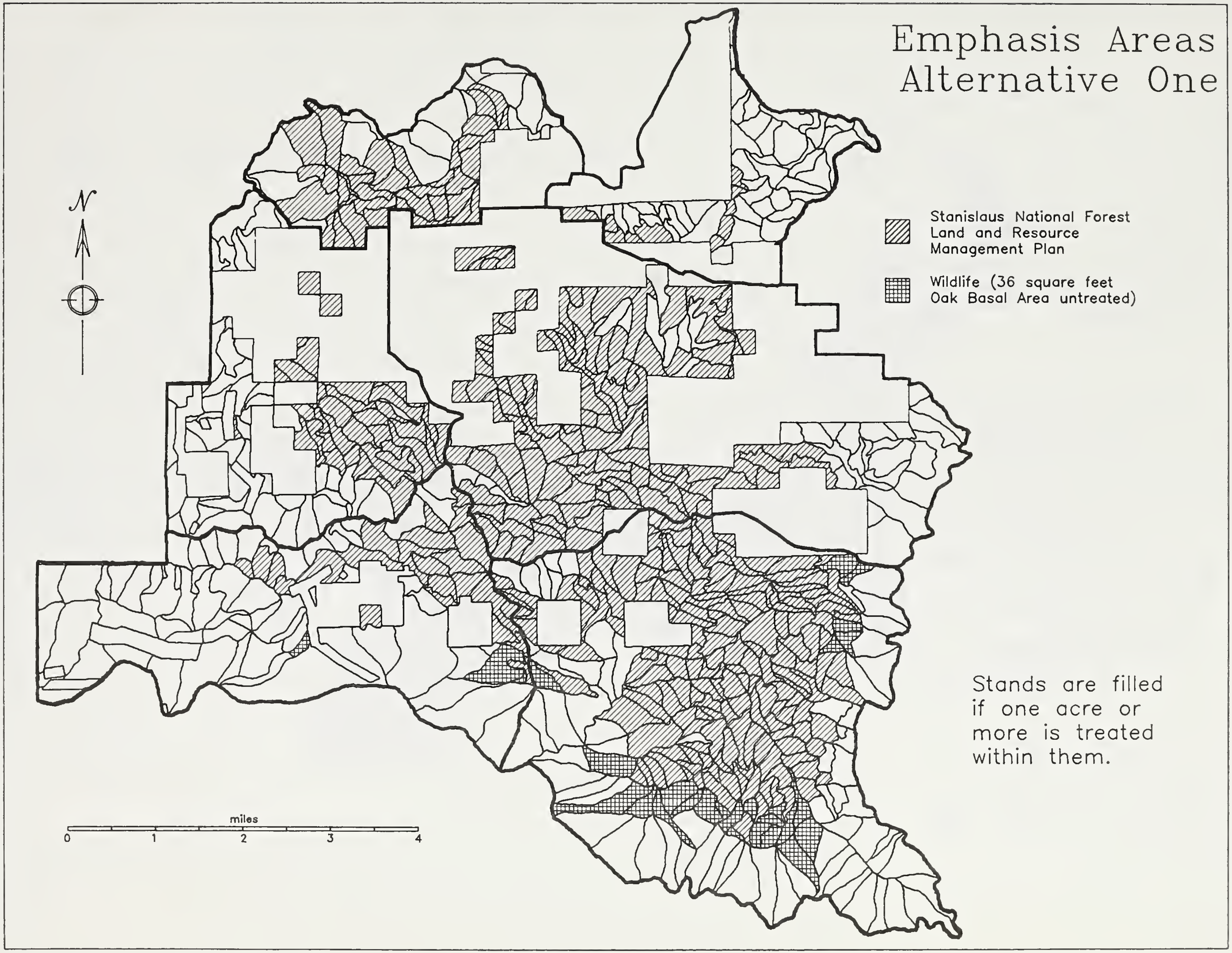
Broadcast burning would occur in three different areas for three related purposes: Steep slopes where high brush prevents planting; in areas scheduled to be planted where fuel loading is above forest standards; and where fuels outside of planted areas present a fire hazard to the planted areas.

Roughly 671 acres within the project area are located on steep slopes where dense brush exceeds 4 feet in height. Eliminating the brush by burning would allow workers access for planting. Burning would occur after the brush has been aerially treated with hexazinone and allowed to brown. Once "browned," the area is burned by helitorch, a method in which gasoline-based alumagel is ignited and dropped onto the area from a helicopter. Where feasible, a ground crew would hand fire the area using a driptorch.

Broadcast burning in other areas where fuel loading is exceptionally high would reduce the threat of larger fires, in addition to preparing the site for planting. In 1994 and 1995, broadcast burning is scheduled on a total of 456 acres yet to be planted and containing high fuel loading. Aerial applications of hexazinone would be deferred in these areas for one season. Hexazinone binds to ash and charcoal, and the time gap would allow these materials to weather to a point that hexazinone would be able to infiltrate past the ash layer. (Refer to Chapter IV, "Air Quality," and "Fire/fuels" for specific stands and years.)

Over the span of 4 years, broadcast burning would also occur on 2,205 acres adjacent to reforested areas to reduce fire risks in the project area, and therefore protect the overall investment in reforestation. The burning outside of plantation areas is a lower intensity burn compared to burning as a method of site preparation. Stands to be burned strictly for fuels reduction are listed on page IV-7.

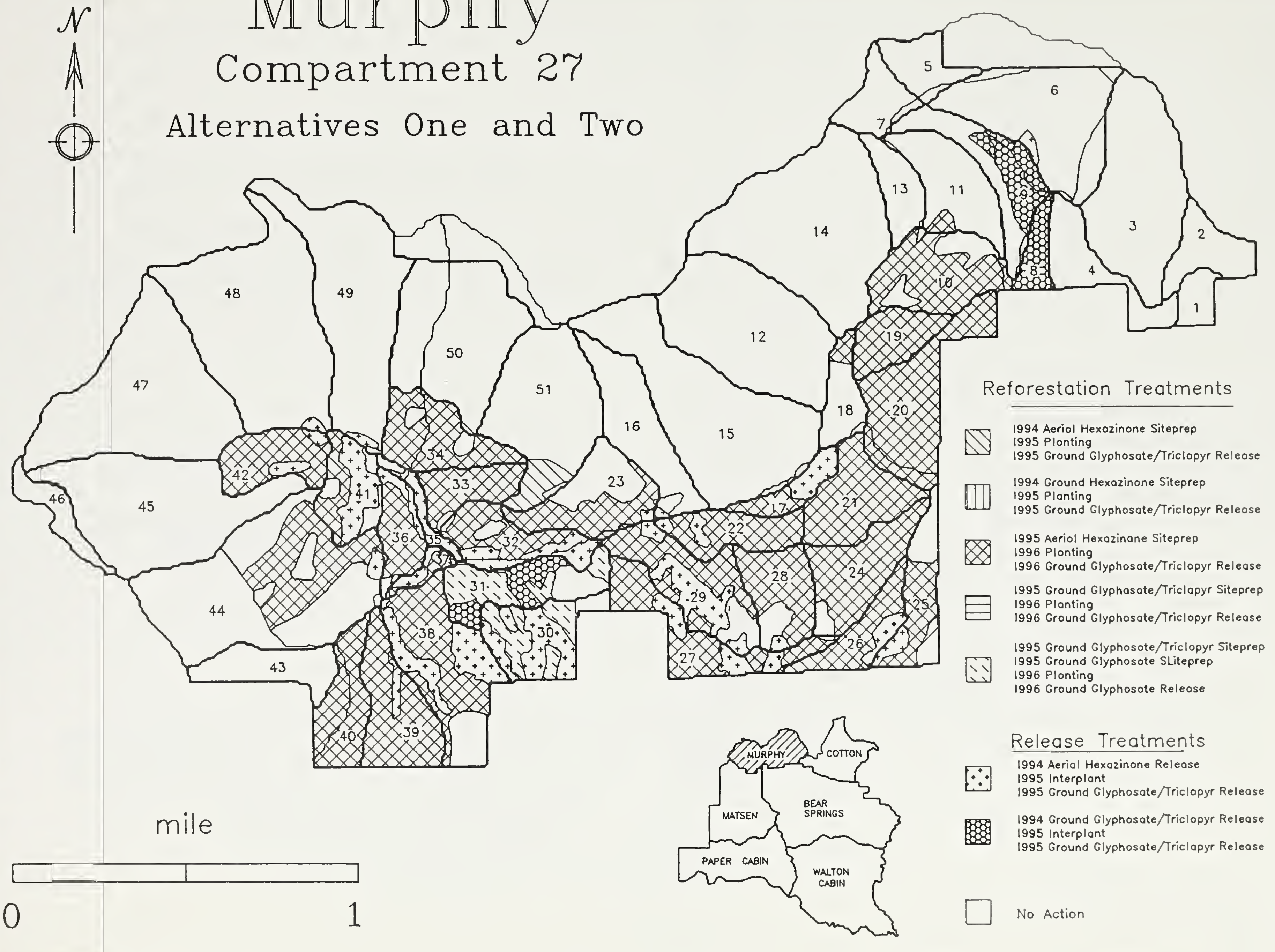
Pages II-10 through II-15 illustrate treatments for Alternatives 1 and 2. They show treatments by compartments and stands.


Emphasis Areas
Alternative One
Stanislaus National Forest
Land and Resource
Management Plan
Wildlife (36 square feet
Oak Basal Area untreated)
Stands are filled
if one acre or
more is treated
within them.
N
miles
0
1
2
3
4

Murphy

Compartment 27

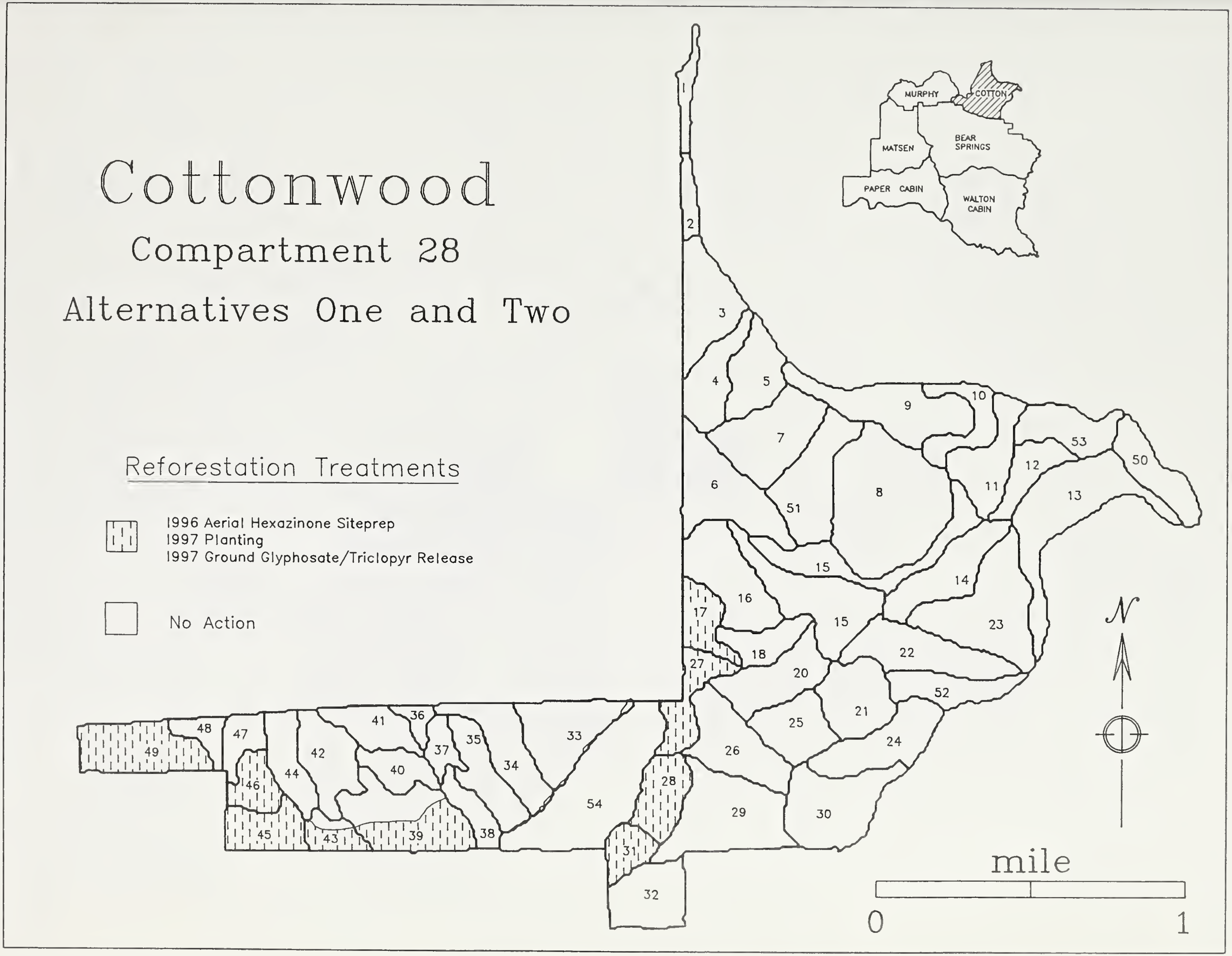
Alternatives One and Two



Cottonwood

Compartment 28

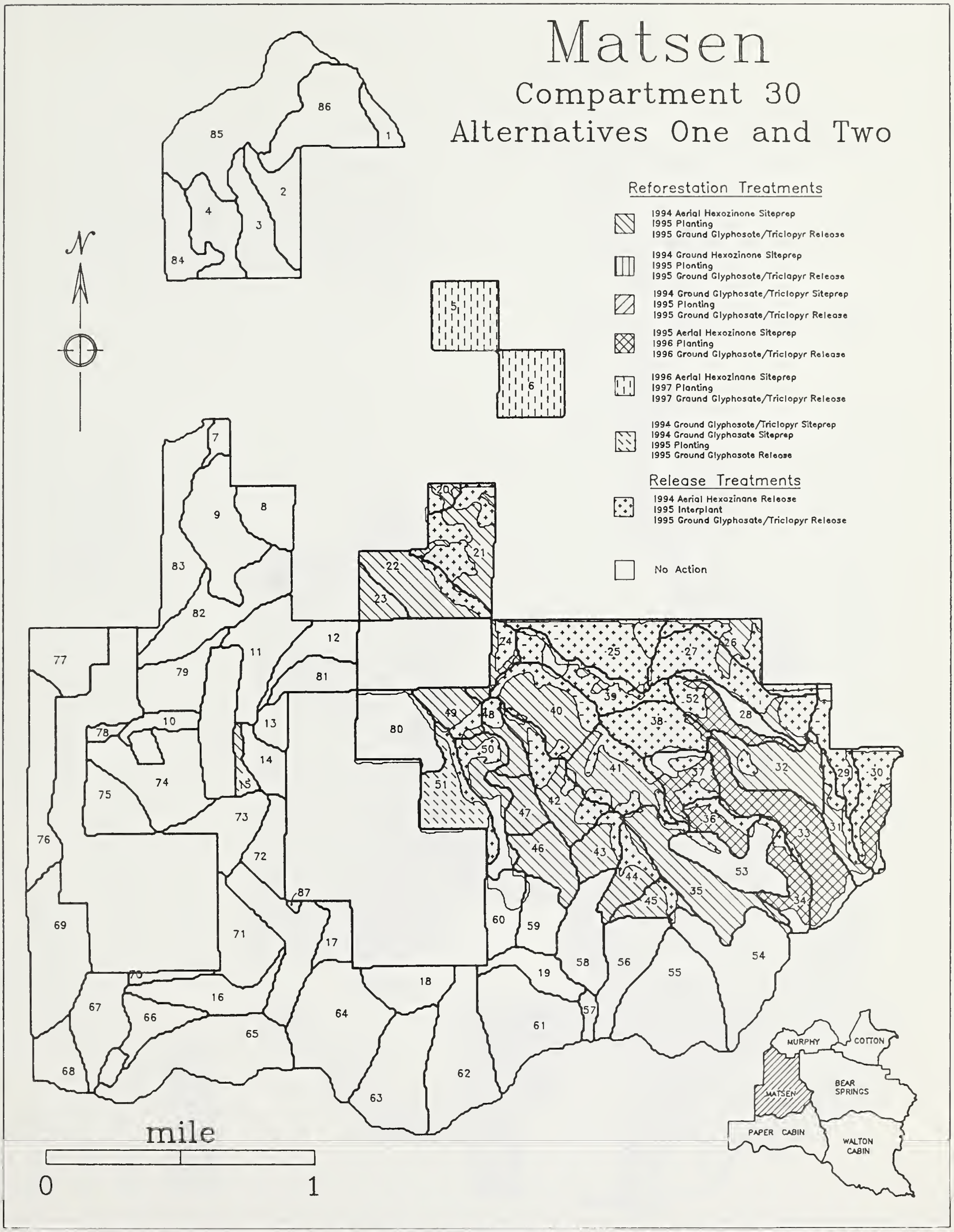
Alternatives One and Two



Reforestation Treatments

1996 Aerial Hexazinone Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release

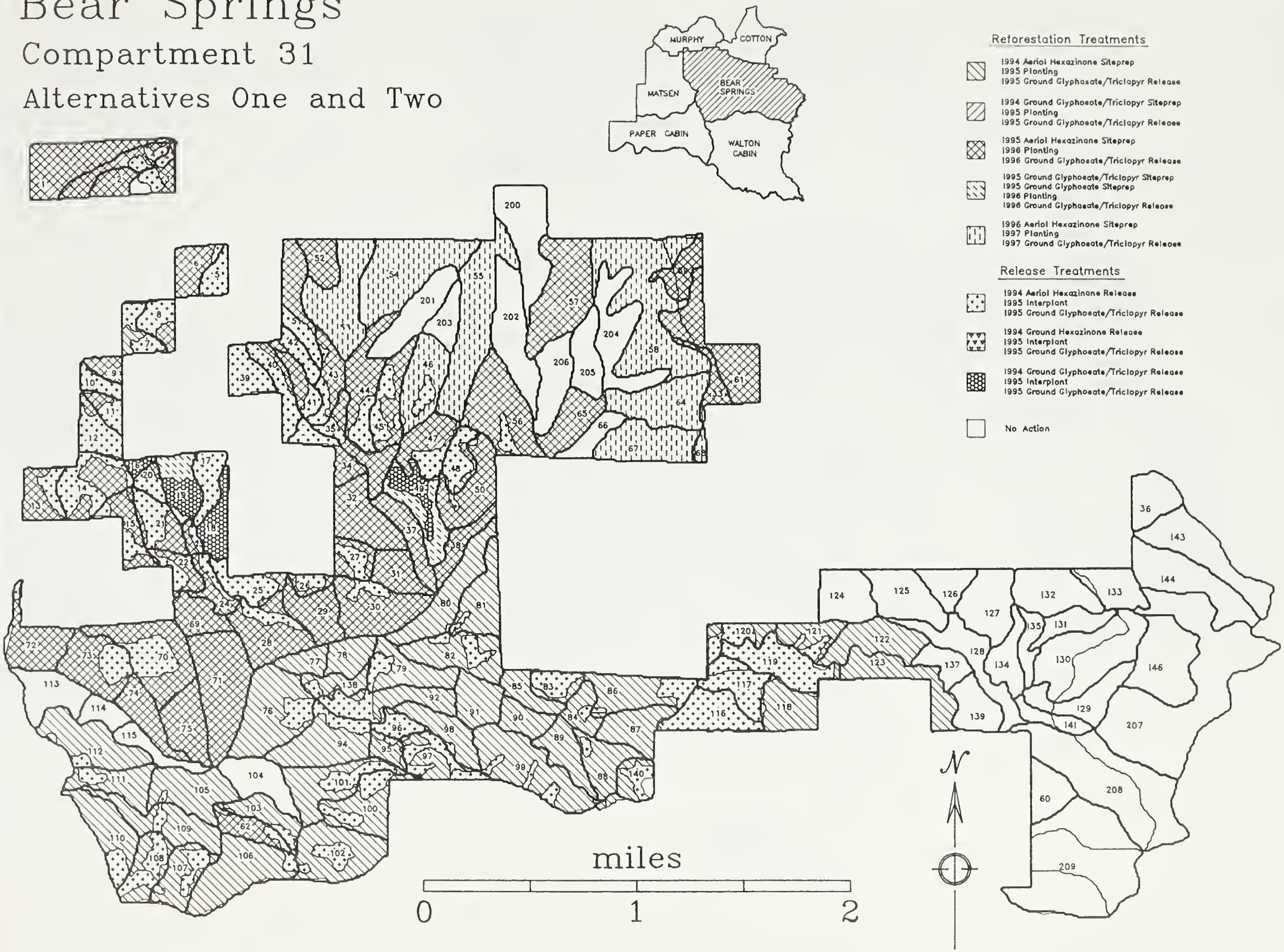
No Action


Matsen
Compartment 30
Alternatives One and Two
Reforestation Treatments
1994 Aerial Hexozinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Hexozinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1995 Aerial Hexozinone Siteprep
1996 Planting
1996 Ground Glyphosate/Triclopyr Release
1996 Aerial Hexozinone Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1994 Ground Glyphosate Siteprep
1995 Planting
1995 Ground Glyphosate Release
Release Treatments
1994 Aerial Hexazinone Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
No Action
N
mile
0
1
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN

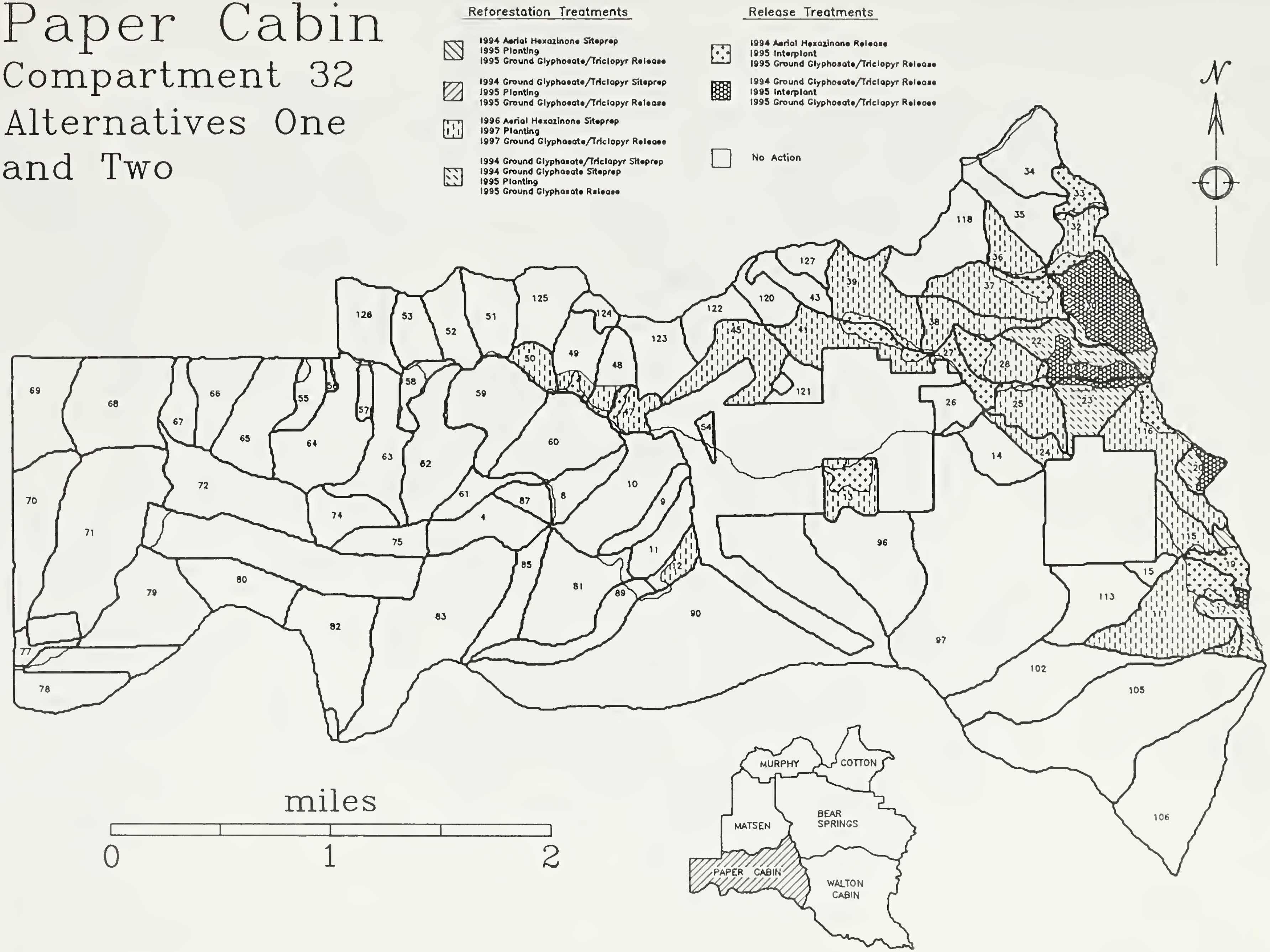
Bear Springs

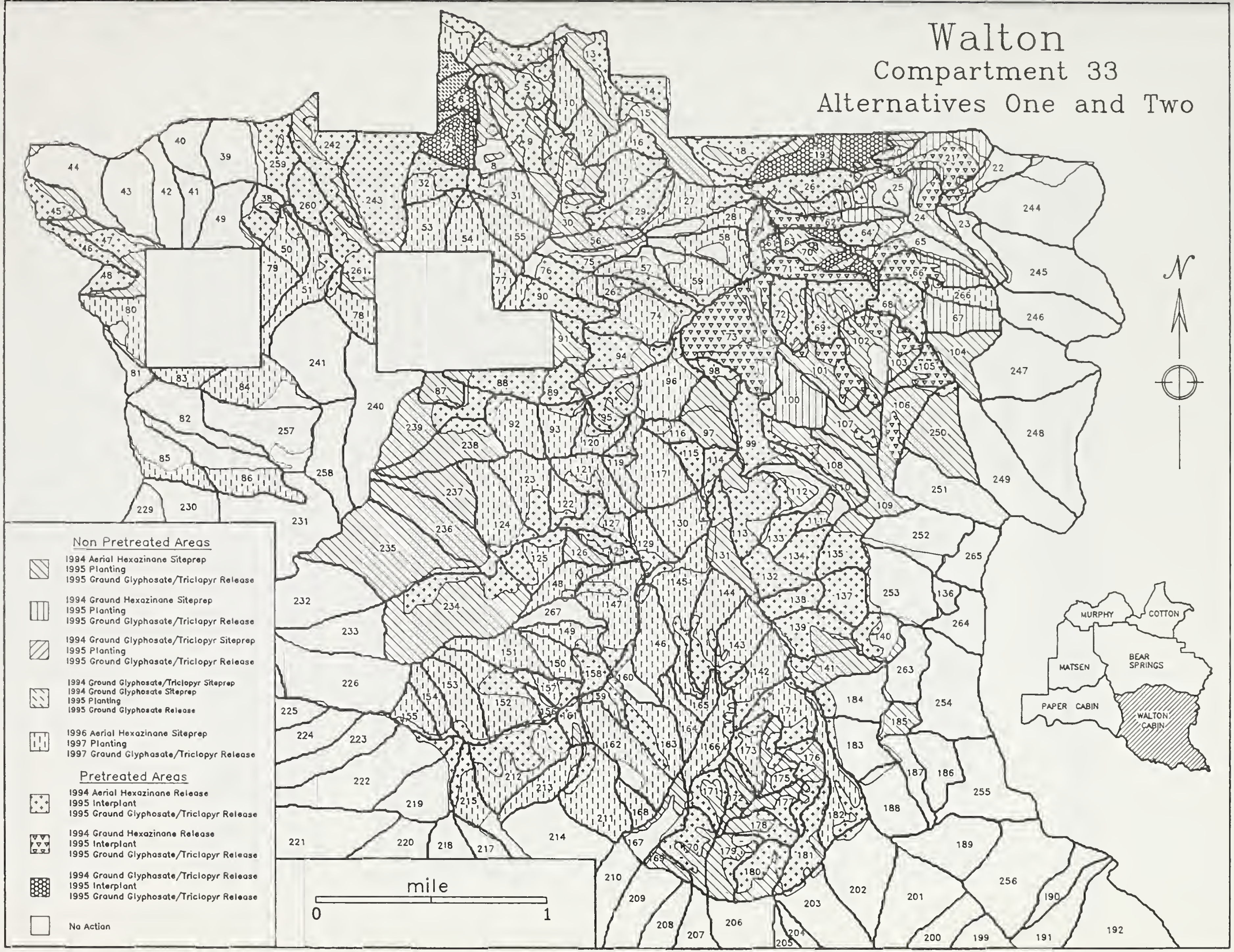
Compartment 31

Alternatives One and Two



Paper Cabin Compartment 32 Alternatives One and Two




Walton
Compartment 33
Alternatives One and Two
N
Non Pretreated Areas
1994 Aerial Hexazinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Hexazinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1994 Ground Glyphosate Siteprep
1995 Planting
1995 Ground Glyphosate Release
1996 Aerial Hexazinone Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
Pretreated Areas
1994 Aerial Hexazinone Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Hexazinone Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
No Action
mile
0
1
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN

Alternative 2: Maintain and establish a conifer forest on 11,750 capable, available and suitable acres to meet LMP standards and incorporate new deer winter range use information. This alternative uses aerial and ground applications of herbicides.

This is the agency preferred alternative.

This alternative would reforest 11,750 acres. Of this amount 3,780 acres have already been deeptilled and planted. A total of 7,970 acres unsuitable for deeptilling would be planted. Planted areas would be released, and areas yet to be planted would be site prepped and released using a variety of herbicide applications. The number of acres treated remain the same as Alternative 1 (Refer to Table II-2, "Treatment Scenarios for Alternatives 1 and 2").

Alternative 2 is tailored to meet long term deer habitat requirements for browse and cover in winter range that was severely impacted by fire. These provisions are based on new information regarding deer use obtained by telemetry research (J. Maddox, California Department of Fish and Game, 1986-1992; refer to Appendix 7). The study identifies specific areas of deer concentration and migration routes in the project area. It would constitute an amendment to the LMP critical deer winter range map (LMP, Appendix I, Map 2). A description of the basis for the study and methods used is discussed in more detail in Chapter III, Wildlife, and Appendix 7.

While the deer winter range locations identified in this alternative are significantly different as compared to the Forest Plan, the provisions follow the existing standards and guidelines. The Plan requires an average of 36 square feet basal area per acre of oaks (36 sqft/acre of oaks) in areas identified as critical deer winter range (LMP, p. IV-177).

The Forest Plan management objectives of cover-to-forage ratios range between 75/25 and 45/55 (LMP p. IV-174). The management objectives of Alternative 2 are designed to remain within that range to provide a high level of oak retention in areas to be managed for forage values and to provide improved forage conditions in the Clavey River Canyon, in scattered areas adjacent to meadows and along migration routes in upper Hunter Creek. This alternative contains two prescriptions to meet this objective: 36 sqft/acre of oaks (Oak 36) and 20 sqft/acre of oaks (Oak 20). Oak 36 is assigned in areas of heavy deer concentration. Oak 20 is assigned to travel corridors where lower levels of hardwoods are needed to sustain deer during migration from one area to another. The location of these critical deer habitat areas are illustrated in the "Emphasis Map for Alternatives 2 and 3" on page II-21.

Alternative 2 would provide 2,467 acres of intensive oak prescription at 36 sqft/acre to attain desired cover to forage ratios. Another 862 acres would be designated 20 sqft/acre of oaks. These acres of emphasis would be spatially arranged to attain the desired ratios and to complement deer habitat values on private lands within the project area. This emphasis would provide additional capabilities for wintering mule deer and other oak dependent species, including the western gray squirrel and mountain quail. (Refer to Table II-4, "Acres of Treatment by Emphasis in Alternative 2").

Table II-4 **Acres of Treatment by Emphasis in Alternative 2**

TREATMENT	EMPHASIS	ACRES
Aerial Release (hexazinone)	Oak 20	192
Aerial Site Prep (hexazinone)	Oak 20	625
Ground Release (hexazinone)	Oak 20	13
Ground Site Prep (hexazinone)	Oak 20	32
TOTAL	Oak 20	862
Aerial Release (hexazinone)	Oak 36	715
Aerial Site Prep (hexazinone)	Oak 36	1543
Ground Release (hexazinone)	Oak 36	22
Ground Site Prep (hexazinone)	Oak 36	49
Ground Site Prep (glyphosate)	Oak 36	62
Ground Release (glyphosate-triclopyr)	Oak 36	76
TOTAL	Oak 36	2467
Aerial Release (hexazinone)	LMP	2353
Aerial Site Prep (hexazinone)	LMP	5392
Ground Release (hexazinone)	LMP	142
Ground Site Prep (hexazinone)	LMP	67
Ground Release (glyphosate-triclopyr)	LMP	267
Ground Site Prep (glyphosate)	LMP	200
TOTAL	LMP	8421

The number of acres assigned a specific treatment would remain the same in Alternatives 1 and 2. However, in Alternative 2, the treatments would be tailored in significantly more acres to meet the increased deer winter range objectives. In areas treated with aerial hexazinone and assigned an Oak 36 or Oak 20 emphasis, the helicopter pilot would be required by contract to avoid oaks in areas of concentrated deer winter range and deer migratory routes. This would be achieved by adjusting the flight pattern to avoid oaks and/or by shutting off the herbicide applicator when flying over these areas. Coincidentally, browse species for wildlife would be retained to meet Forest Plan guidelines (LMP, IV-174).

Where liquid hexazinone is ground-applied, the hand crew would remain outside the drip line of the oaks to prevent herbicide from entering their root zones. Where glyphosate and triclopyr are used, the hand crew would avoid spraying oaks in areas designated for deer winter range objectives.

Managing for deer habitat would also result in fewer conifers planted, due to the higher oak densities, and a decreased timber yield, compared to Alternative 1. (See Appendix 3, "Expected Timber Yield, Economic Costs and Returns").

Alternative 2 would conduct release and site preparation over a span of four years. (See Table II-5, "Acres of Treatment by Year for Alternative 2"). Treatment activities would begin in March, 1994, when acres that have been deeptilled and planted would be released using aerial applications of granular hexazinone (Pronone 10G). At the same time, granular hexazinone would be aerially applied to prepare sites for planting.

Table II-5 **Acres of Treatment by Year for Alternative 2**

Treatment	1994	1995	1996	1997
Aerial Release (hexazinone)	3260			
Aerial Site Prep (hexazinone)	2691	1994	2875	
Ground Release (hexazinone)	177			
Ground Site Prep (hexazinone)	148			
Ground Site Prep (glyphosate)	133	57	72	
Ground Release (glyphosate-triclopyr)	343	6772	2051	2947
Ground Site Prep (glyphosate-triclopyr)	133	57	72	
Site Prep Burning	906	191	30	
Fuel Reduction Burning	209	778	798	420
Plant		2972	2051	2947
Interplant		3780		

Where sensitive plants exist, applications would be modified to avoid populations (see Chapter II, Management Requirements and Mitigations, "Vegetation/Sensitive Species") by ground applying liquid hexazinone (Velpar L) from backpack sprayers. Site preparation using hexazinone would continue in subsequent project years. Since hexazinone is a root-active herbicide, it would be applied in March to ensure that sufficient rainfall moves the herbicide into the root zone of competing plants. All aerial operations would remain outside the 0.25 mile buffer zone for California Spotted Owl activity site from March 1 to August 15 to avoid disturbing owl breeding and nesting.

Following release and site preparation treatments, interplanting and planting are scheduled in January and February, when soil temperature and moisture are optimum. Deeptilled areas would be interplanted to fill in places where seedling mortality has occurred. At this time, sugar pine, incense cedar and white fir would be intermixed with existing ponderosa pine and douglas fir. (Since sugar pine, incense cedar and white fir are sensitive to hexazinone, planting these three species would be deferred until the hexazinone has biodegraded). Planting in areas yet to be reforested would start in January and February, 1995, with a mix of ponderosa pine, douglas fir, sugar pine, incense cedar and white fir. Up to 30 percent conifer species other than ponderosa pine would be planted. Ponderosa pine, the most abundant conifer at low to middle elevations, would make up the remaining 70 percent.

In areas where hexazinone cannot be used due to sandy soils, the areas would be site prepped twice using a spring hand application of glyphosate (Accord), followed by a summer application of glyphosate and triclopyr (Accord and Garlon 4). After planting, the areas would be released using a tank mix of glyphosate and triclopyr.

Glyphosate would be applied in early April to treat unwanted grasses and forbs. The tank mixture of glyphosate-triclopyr would be applied over the same area to treat missed and/or recovering competing plants, particularly brush-type species. Glyphosate-triclopyr treatments would be scheduled in May of each project year, since these foliar-active herbicides are most effective when applied during dry weather to the above ground portion of unwanted vegetation.

Buffer strips, as described earlier, apply to this alternative also.

Broadcast burning would occur in three different areas for three related purposes: Steep slopes where high brush prevents planting; in areas scheduled to be planted where fuel loading is above forest standards; and where fuels outside of planted areas threaten future survival.

Roughly 671 acres within the project area are located on steep slopes where dense brush exceeds 4 feet in height. Eliminating the brush by burning would allow workers access for planting. Burning would occur after the brush has been aerially treated with hexazinone and allowed to brown. Once "browned," the area is burned by helitorch, a method in which gasoline-based alumagel is ignited and dropped onto the area from a helicopter. Where feasible, a ground crew would hand fire the area using a driptorch.

Broadcast burning in other areas where fuel loading is exceptionally high would reduce the threat of larger fires, in addition to preparing the site for planting. From 1994 to 1996, broadcast burning is scheduled on a total of 456 acres yet to be planted and containing high fuel loading.

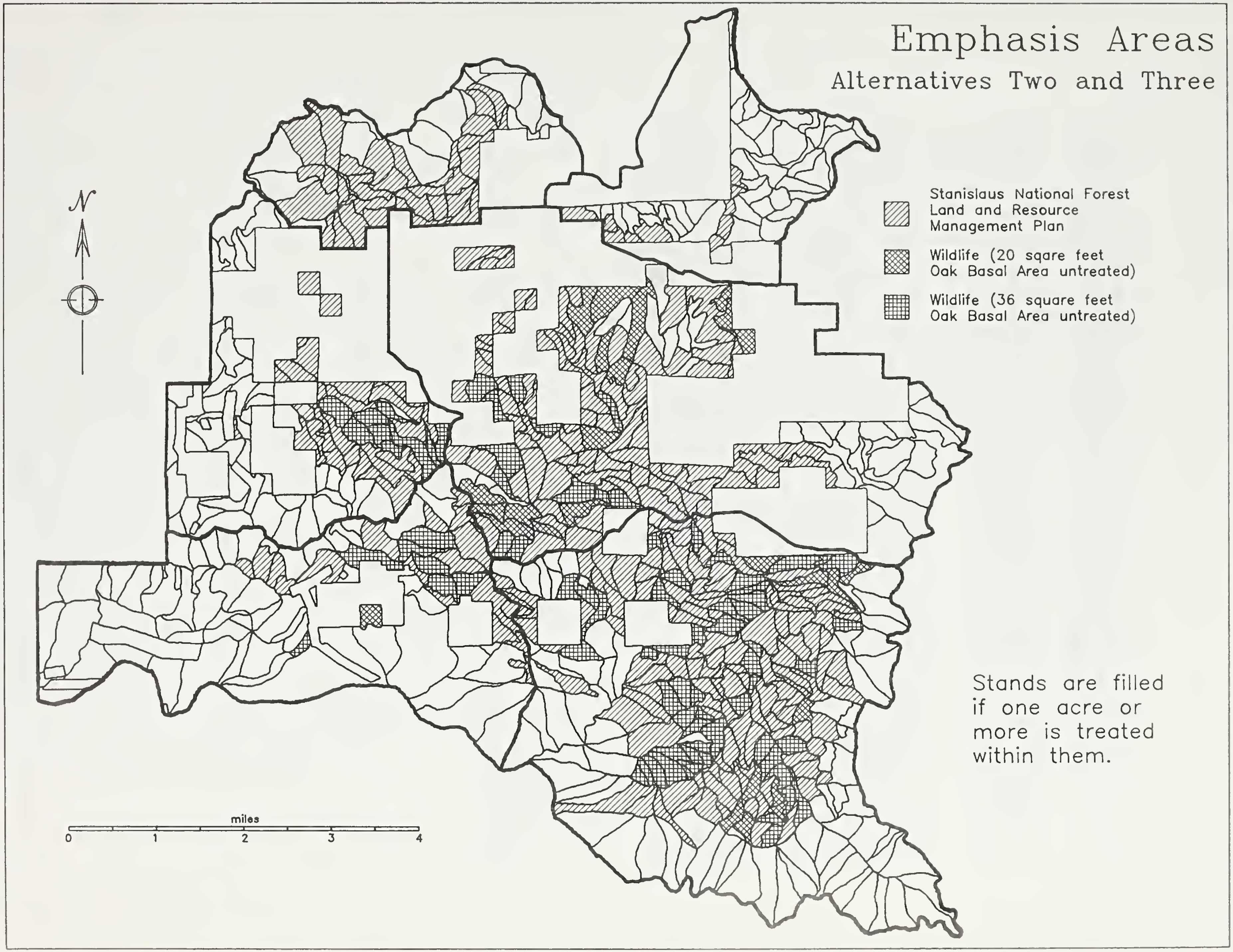
Aerial applications of hexazinone would be deferred in these areas for one year from the time of the burn. Hexazinone binds to ash and charcoal, and the time gap would allow these materials to weather to a point that hexazinone would not adhere. (Refer to Chapter IV, "Air Quality," and "Fire/fuels" for specific stands and years.)

Over the span of 4 years, broadcast burning would also occur on 2,205 acres adjacent to reforested areas to reduce fire risks in the project area, and therefore protect the overall investment in reforestation. The burning outside of plantation areas is a lower intensity burn compared to burning as a method of site preparation.

Treatments by compartment and stand for Alternative 2 are on pages II-10 through II-15.

Emphasis Areas

Alternatives Two and Three



Alternative 3: Maintain and establish a conifer forest on 11,079 capable, available and suitable acres to meet LMP standards and incorporate new deer winter range use information. This alternative uses herbicide, but eliminates aerial herbicide application.

This alternative would reforest 11,079 acres. Of this amount 3,780 acres have already been deeptilled and planted. A total of 7,299 acres unsuitable for deeptilling would be treated with herbicides, then planted. Both the existing planted areas and areas yet to be planted would be released and site prepped using a variety of herbicide applications (Refer to Table II-6, "Treatment Scenarios for Alternative 3").

Like Alternative 2, this alternative is tailored to meet long term deer habitat requirements for browse and cover in concentrated deer winter range that was severely impacted by fire. These provisions are based on new information regarding concentrated deer winter range and migration routes obtained by telemetry research (J. Maddox, California Department of Fish and Game, 1986-1992; refer to Appendix 7). The study identifies specific areas of deer concentration and migration routes in the project area. A more detailed description of the basis for the study and methods used is discussed Chapter III, Wildlife, and Appendix 7.

Alternative 3 is distinguished from Alternative 2 by the elimination of aerial spraying, in response to Issue 6, described in Chapter I, "How is human health affected by the use of herbicides during reforestation activities?" Consequently, this alternative eliminates 671 acres on steep slopes with high brush that are unfeasible to treat without aerial applications of herbicide. In this alternative, those acres would remain untreated. Following is Table II-6, which shows proposed treatments scenarios by stand:

Table II-6 Treatment Scenarios for Alternative 3

Compartment	Stand #s	Broad Burn; Ground Hex; Grnd Gly/Tri	Grnd Hex; Grnd Gly/Tri	Grnd Gly/Tri Grnd Gly/Tri	Grnd Gly; Grnd Gly/Tri Grnd Gly/Tri
Murphy	8,9,30,31 10,11,16-29,32-42,44,48,49,51 30,31		 784 	67 	 61
Cotton wood	17,27,28,31,39,43,45,46,49		164		
Matsen	5,6,15,20-54 51		976 		 20

Compart ment	Stand #s	Broad Burn; Ground Hex; Grnd Gly/Trl	Grnd Hex; Grnd Gly/Tri	Grnd Gly/Tri Grnd Gly/Tri	Grnd Gly; Grnd Gly/Tri Grnd Gly/Tri
Bear Springs	1-15,17, 20-35,37-48,50-52, 55-57,59, 61,62,65, 68-76, 78,79, 81-89,91, 92,94-103, 105-112, 116-121, 123,138, 140		2637		
	16,18,19, 49			57	
	19,49				41
	46,53,54, 56,58,67	404			
Paper Cabin	12,13,19, 24,25,27, 28,32,33, 36-39,41, 45,47-50, 111,112, 115,116		733		
	47-50	52			
	17,20,22, 23,30			124	
	17,20,22, 23,30				95
Walton	1,2,5,8-19 21,24-32, 38,44-51, 53-60,62, 64-80,83-135,137-185, 202,203, 211-213, 215,219, 222,234-239,242, 243,250, 251,253, 259-262, 266		4724		
	4,6,7,61, 63,70,				45
	2,6,7,61, 63,70			95	
Grand	Totals	456	10,018	343	262

Although the deer winter range in this alternative differs significantly from those identified in the Forest Plan, the provisions for these areas follow the standards and guidelines in the Forest Plan for critical range. The Plan requires that areas subjected to wildfire provide an average of 36 square feet basal area per acre of oaks (36 sqft/acre of oaks) in areas identified as critical deer winter range (LMP, p. IV-177). In this alternative, the Forest Plan standard is applied in those areas identified in the aforementioned telemetry research (refer to Appendix 7).

The Forest Plan management objectives of cover-to-forage range between 75/25 and 45/55 (LMP p. IV-174). The management objectives of Alternative 3 are designed to remain within that range to provide a high level of oak retention in areas to be managed for forage values and to provide improved forage conditions in scattered areas adjacent to meadows and along migration routes in upper Hunter Creek and the Clavey River canyon (LMP p. IV-177). This alternative has two prescriptions for oak management: Oak 36 and Oak 20. Oak 36 would be prescribed in areas with heavy concentration of deer. Oak 20 would be prescribed in corridors of less concentration where deer are known to migrate from one area to another. The location of these critical deer habitat areas are illustrated in the "Emphasis Map for Alternatives 2 and 3" on page II-21.

Alternative 3 would provide 2,374 acres of intensive oak prescription of 36 sqft/acre to attain desired cover to forage ratios. Another 807 acres would designate 20 sqft/acre of oaks. These acres of emphasis would be spatially arranged to attain the desired ratios and to complement deer habitat values on private lands within the project area. This emphasis would provide additional capabilities for wintering mule deer and other oak dependent species, including the western gray squirrel and mountain quail. (Refer to Table II-7, "Acres of Treatment by Emphasis in Alternative 3").

Table II-7 **Acres of Treatment by Emphasis in Alternative 3**

TREATMENT	EMPHASIS	ACRES
Ground Release (hexazinone)	Oak 20	205
Ground Site Prep (hexazinone)	Oak 20	602
TOTAL	Oak 20	807
Ground Release (hexazinone)	Oak 36	779
Ground Site Prep (hexazinone)	Oak 36	1499
Ground Release (glyphosate-triclopyr)	Oak 36	34
Ground Site Prep (glyphosate-triclopyr)	Oak 36	62
TOTAL	Oak 36	2374
Ground Release (hexazinone)	LMP	2494
Ground Site Prep (hexazinone)	LMP	4936
Ground Release (glyphosate-triclopyr)	LMP	268
Ground Site Prep (glyphosate)	LMP	200
TOTAL	LMP	7898

In Alternative 3, release and site preparation treatments have been tailored to meet the critical deer winter range objective. Where ground hexazinone (Velpar L) is applied, the hand crew would remain outside the drip line of the oaks to prevent herbicide from entering the root zones of the oaks. Where glyphosate and triclopyr are used, the hand crew would avoid spraying oaks in areas designated for deer winter range. Treatment would meet browse species objectives for wildlife according to Forest Plan guidelines (LMP, IV-174)

Managing for deer habitat would also result in fewer conifers planted and a decreased timber yield, compared to Alternative 1. (See Appendix 3, "Expected Timber Yield, Economic Costs and Returns").

Alternative 3 would conduct release and site preparation over a span of four years. (See Table II-8, "Acres of Treatment by Year for Alternative 3"). Treatment activities would begin in March, 1994, when acres that have been deeptilled and planted would be released using ground applications of granular hexazonine. At the same time, hexazinone would be ground applied to prepare sites for planting.

Table II-8 **Acres of Treatment by Year for Alternative 3**

Treatment	1994	1995	1996	1997
Ground Release (hexazinone)	3478			
Ground Site Prep (hexazinone)	2634	1777	2626	
Ground Site Prep (glyphosate)	171	57	34	
Ground Release (glyphosate-triclopyr)	302	6585	1834	2660
Ground Site Prep (glyphosate-triclopyr)	171	57	34	
Site Prep Burning	235	191	30	
Fuel Reduction Burning	209	778	798	420
Plant		2805	1834	2660
Interplant		3780		

Where sensitive plants exist, applications would be modified to avoid populations, applying liquid hexazonine from backpack sprayers. Site preparation using hexazinone would continue in subsequent project years. Since hexazinone is a root-active herbicide, it would be applied in March to ensure that sufficient rainfall moves the herbicide into the root zone of competing plants.

Following release and site preparation treatments, interplanting and planting are scheduled in January and February, when soil temperature and moisture are optimum. Deeptilled areas would be interplanted to fill in places where seedling mortality has occurred. At this time, sugar pine, incense cedar and white fir would be intermixed with existing ponderosa pine and douglas fir. (Since sugar pine, incense cedar and white fir are sensitive to hexazinone, planting these three species would be deferred until the hexazinone has biodegraded). Planting in areas yet to be reforested would start in January and February, 1995, with a mix of ponderosa pine, douglas fir, sugar pine, incense cedar and white fir. Up to 30 percent conifer species other than ponderosa pine would be planted. Ponderosa pine, the most abundant conifer at low to middle elevations, would make up the remaining 70 percent.

In areas where hexazinone cannot be used due to sandy soils, the areas would be site prepped twice using a spring hand application of glyphosate, followed by a summer application of glyphosate-triclopyr. After planting, the areas would be released using a tank mix of glyphosate and triclopyr.

Glyphosate would be applied in early April to treat unwanted grasses and forbs. The tank mixture of glyphosate-triclopyr would be applied over the same area to treat missed and/or recovering competing plants, particularly brush-type species. Glyphosate-triclopyr treatments would be scheduled in May of each project year, since these foliar-active herbicides are most effective when applied during dry weather to the above ground portion of unwanted vegetation.

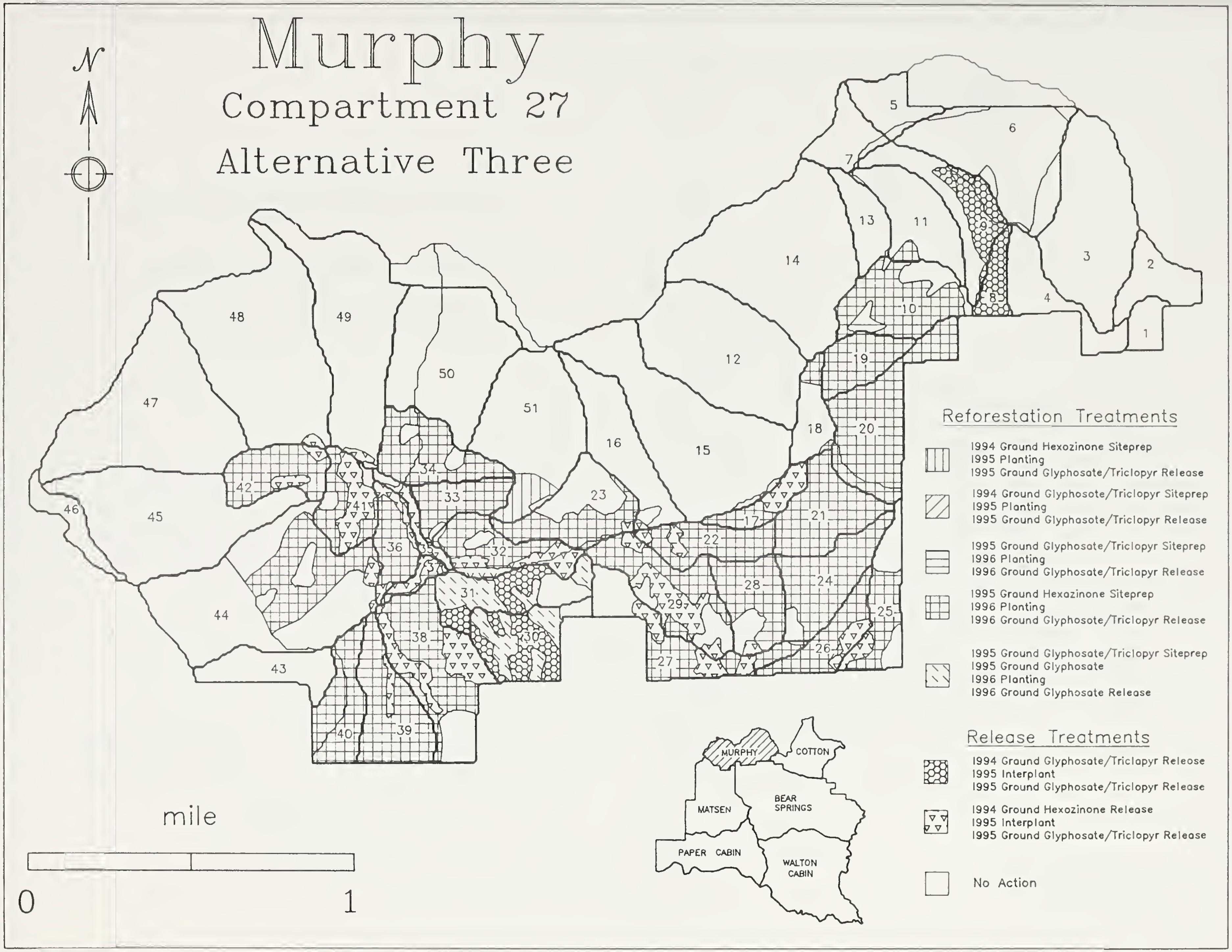
Buffer strips, as outlined for ground applications in Alternative 1, apply to this alternative.

Broadcast burning would occur in two different areas for two related purposes: In areas scheduled to be planted where fuel loading is above forest standards; and where fuels outside of planted areas threaten future survival.

Broadcast burning in areas where fuel loading is exceptionally high would reduce the threat of larger fires, in addition to preparing the site for planting. In 1994 and 1995, broadcast burning is scheduled on a total of 456 acres yet to be planted and containing high fuel loading. Aerial applications of hexazinone would be deferred in these areas for one year from the time of the burn. Hexazinone binds to ash and charcoal, and the time gap would allow these materials to weather to a point that hexazinone would not adhere. (Refer to Chapter IV, "Air Quality," and "Fire/fuels" for specific stands and years.)

Over the span of 4 years, broadcast burning would also occur on 2,205 acres adjacent to reforested areas to reduce fire risks in the project area, and therefore protect the overall investment in reforestation. The burning outside of plantation areas is a lower intensity burn compared to burning as a method of site preparation.

Treatment maps for Alternative 3 are on pages II-28 through 33. They show proposed treatments by compartment and stands.


Murphy
Compartment 27
Alternative Three
N
Reforestation Treatments
1994 Ground Hexozinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1995 Ground Glyphosate/Triclopyr Siteprep
1996 Planting
1996 Ground Glyphosate/Triclopyr Release
1995 Ground Hexazinone Siteprep
1996 Planting
1996 Ground Glyphosate/Triclopyr Release
1995 Ground Glyphosate/Triclopyr Siteprep
1995 Ground Glyphosate
1996 Planting
1996 Ground Glyphosate Release
Release Treatments
1994 Ground Glyphosate/Triclopyr Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Hexozinone Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
No Action
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN
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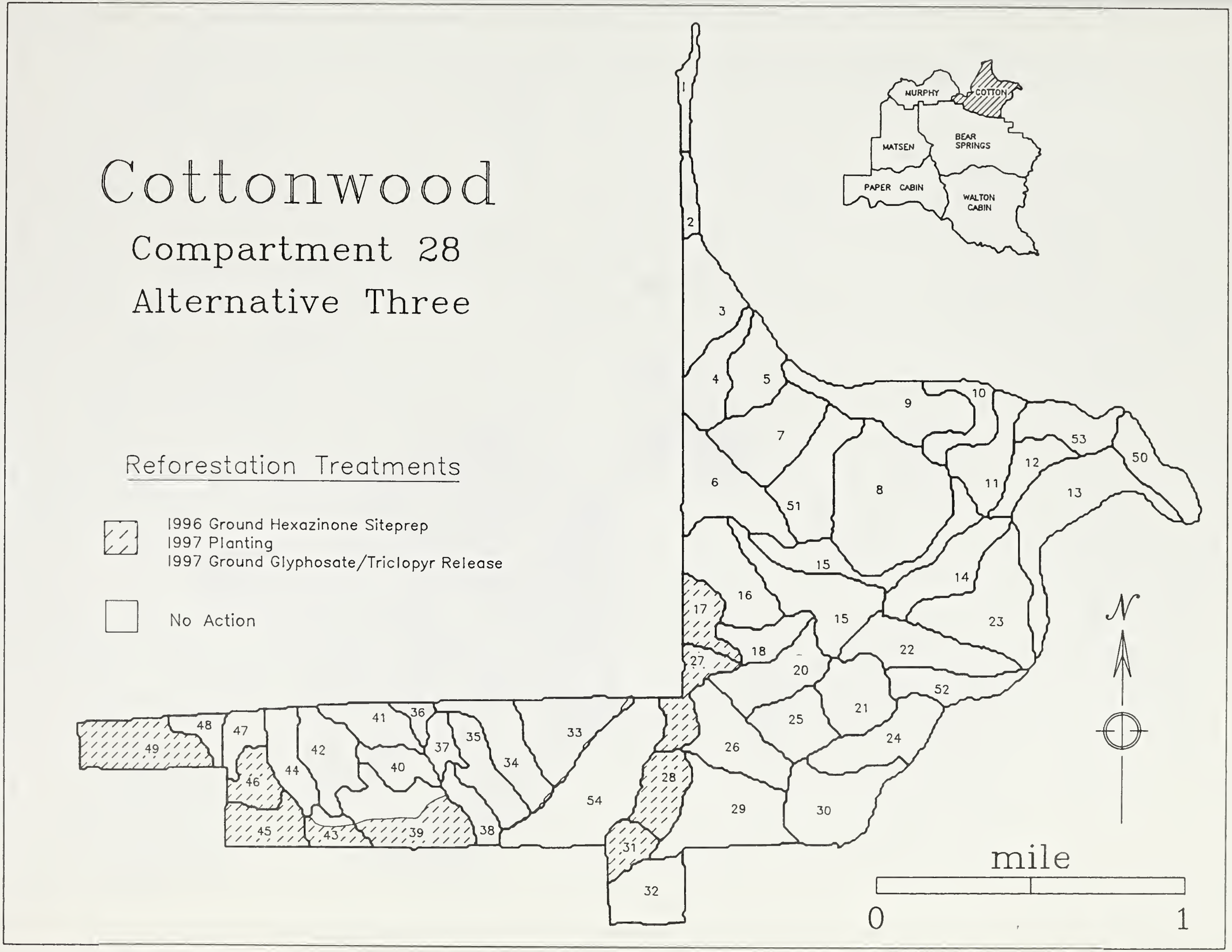
1



Cottonwood
Compartment 28
Alternative Three
Reforestation Treatments
1996 Ground Hexazinone Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
No Action
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN
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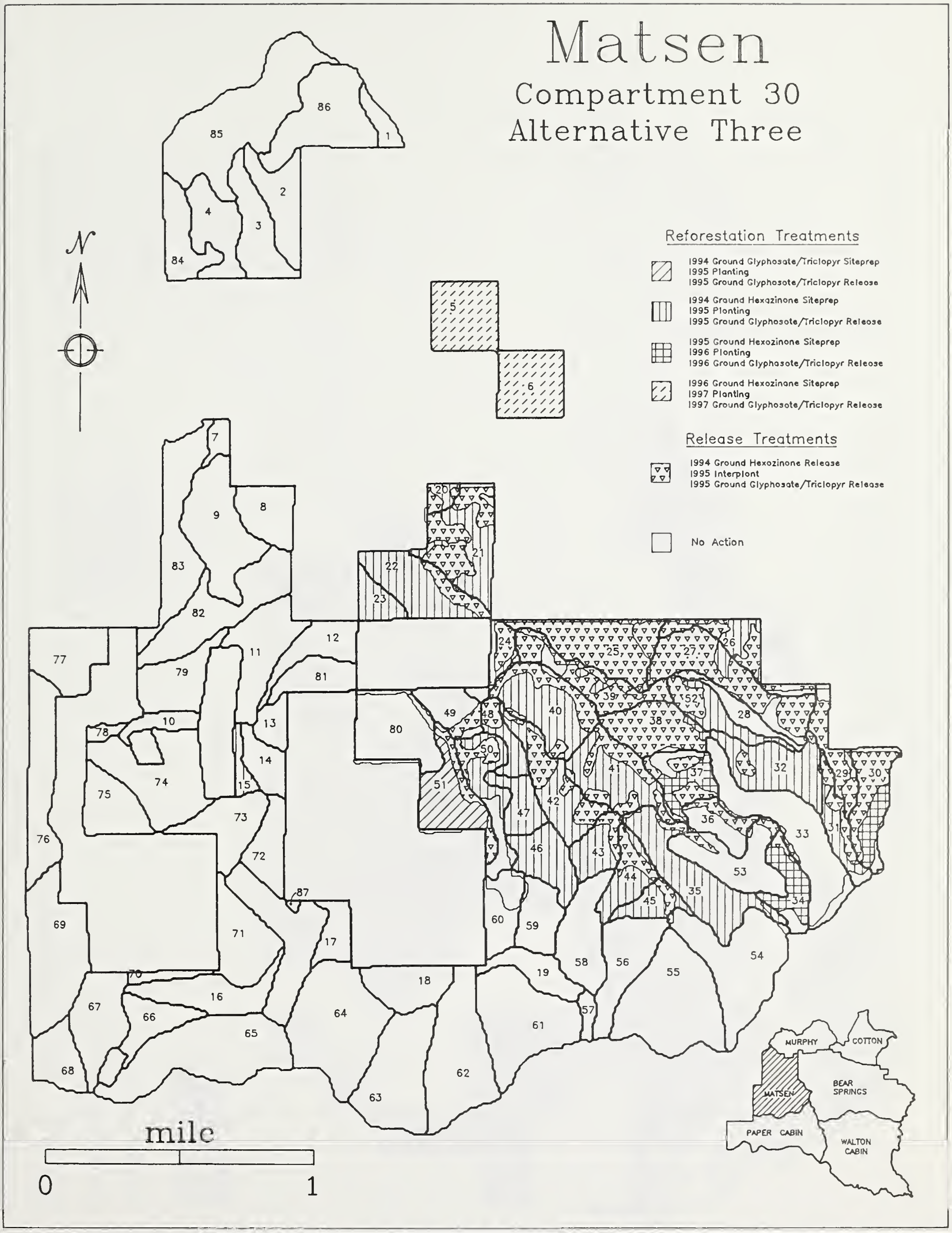
Matsen
Compartment 30
Alternative Three
Reforestation Treatments
1994 Ground Glyphosate/Triclopyr Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Hexazinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1995 Ground Hexazinone Siteprep
1996 Planting
1996 Ground Glyphosate/Triclopyr Release
1996 Ground Hexazinone Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
Release Treatments
1994 Ground Hexazinone Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
No Action
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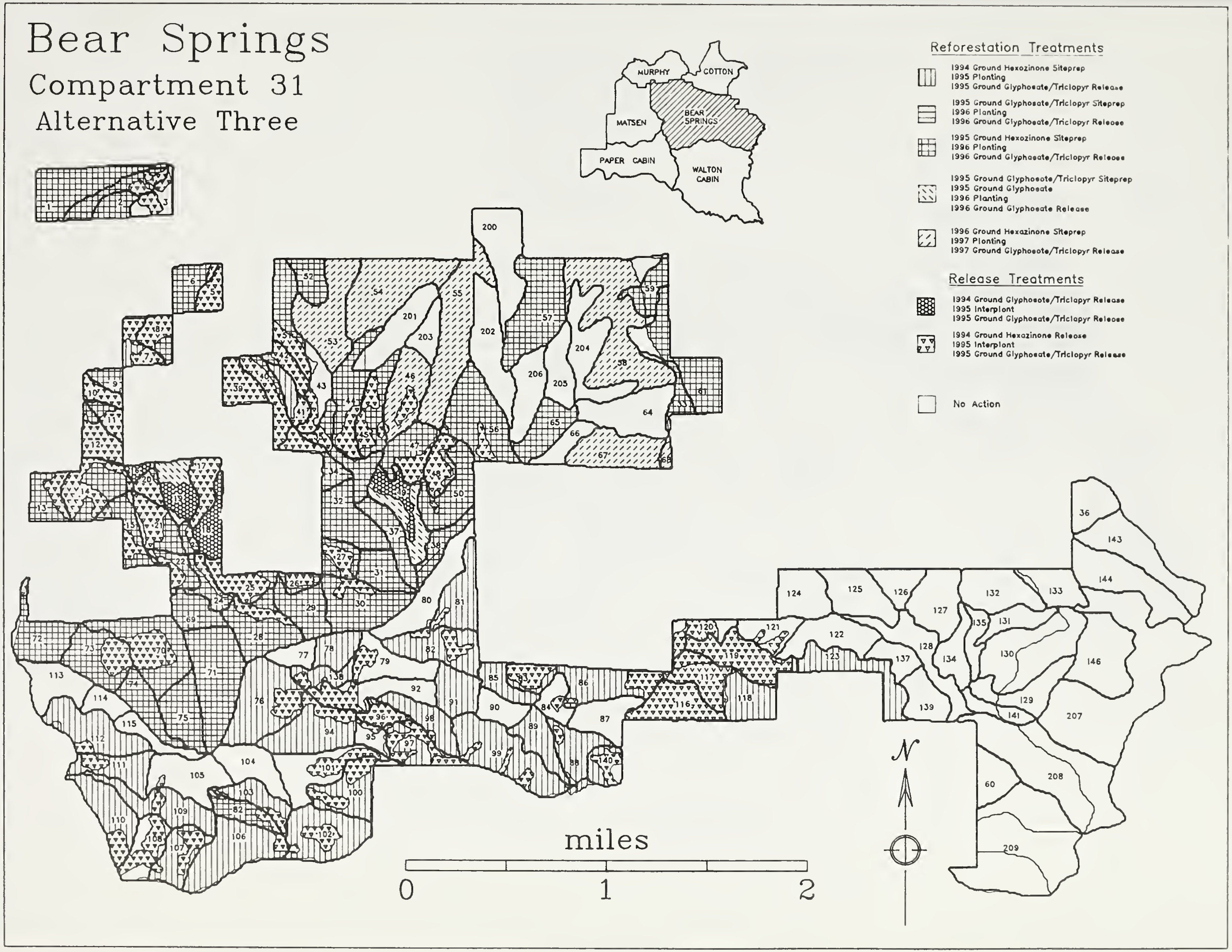
BEAR SPRINGS
MATSEN
PAPER CABIN
WALTON CABIN


Bear Springs
Compartment 31
Alternative Three
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN
Reforestation Treatments
1994 Ground Hexazinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1995 Ground Glyphosate/Triclopyr Siteprep
1996 Planting
1996 Ground Glyphosate/Triclopyr Release
1995 Ground Hexazinone Siteprep
1996 Planting
1996 Ground Glyphosate/Triclopyr Release
1995 Ground Glyphosate/Triclopyr Siteprep
1995 Ground Glyphosate
1996 Planting
1996 Ground Glyphosate Release
1996 Ground Hexazinone Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
Release Treatments
1994 Ground Glyphosate/Triclopyr Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Hexazinone Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
No Action
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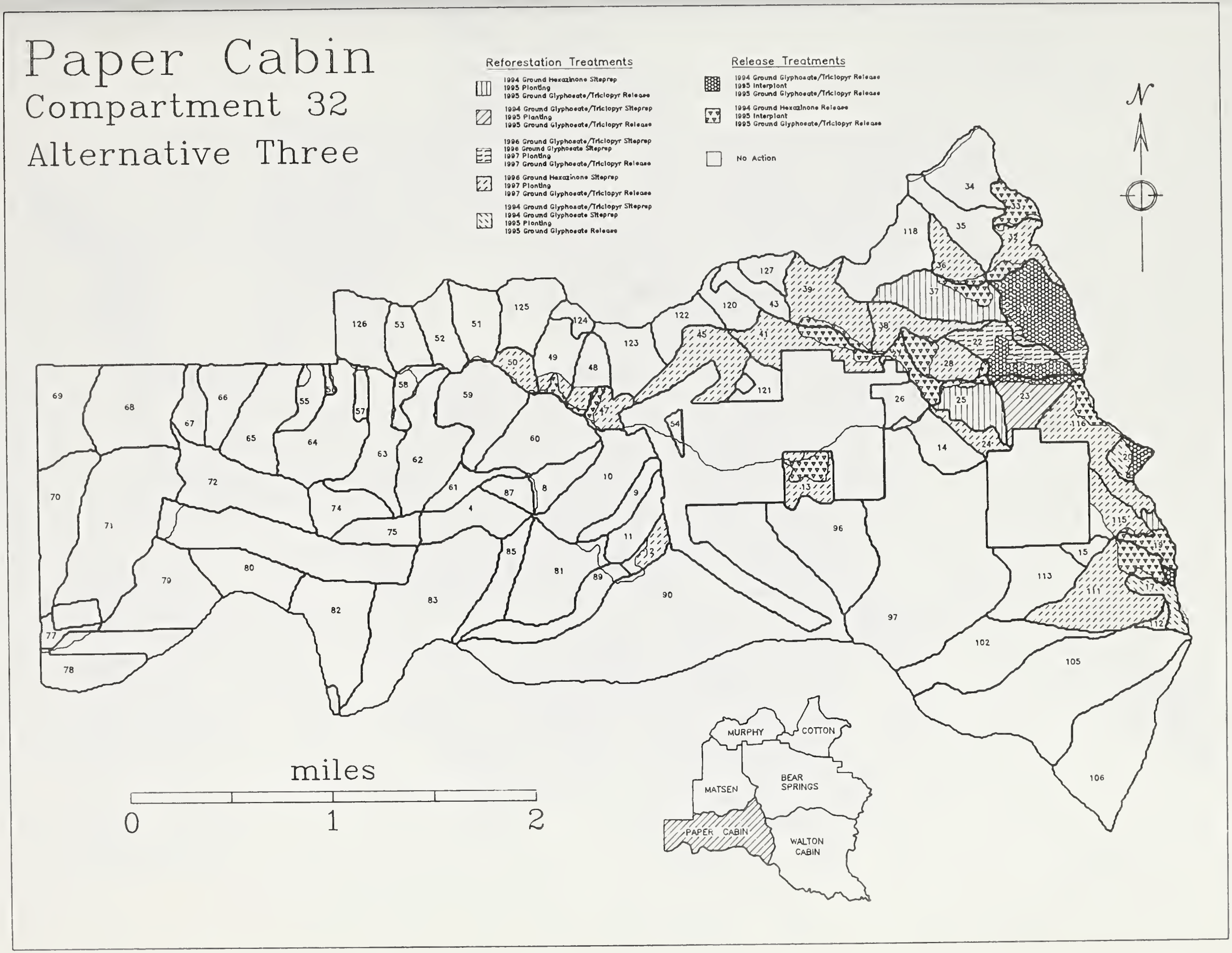
Paper Cabin
Compartment 32
Alternative Three
Reforestation Treatments
1994 Ground Hexazinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1996 Ground Glyphosate/Triclopyr Siteprep
1996 Ground Glyphosate Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
1996 Ground Hexazinone Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1994 Ground Glyphosate Siteprep
1995 Planting
1995 Ground Glyphosate Release
Release Treatments
1994 Ground Glyphosate/Triclopyr Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Hexazinone Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
No Action
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miles
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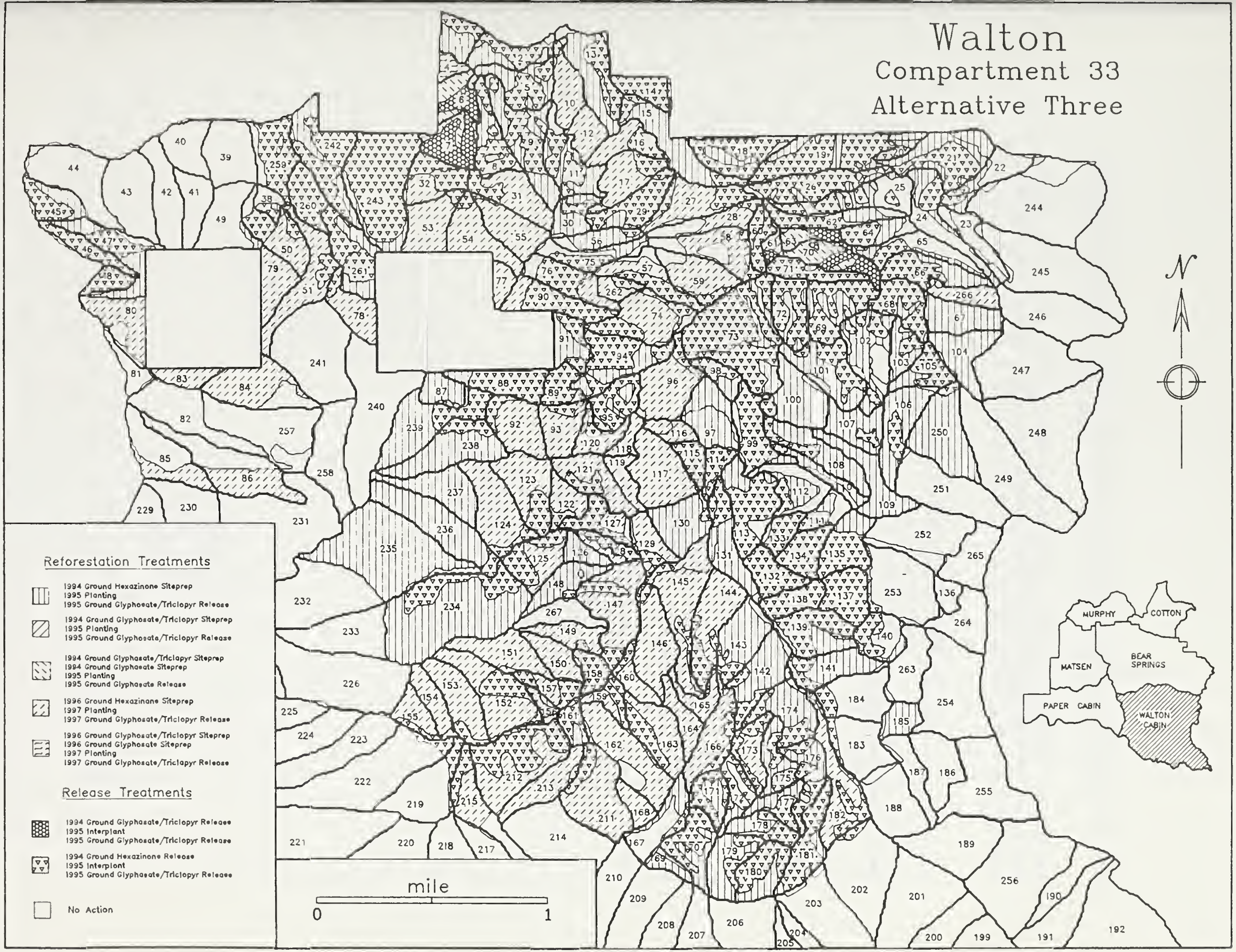
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN


Walton
Compartment 33
Alternative Three
Reforestation Treatments
1994 Ground Hexazinone Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1995 Planting
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Glyphosate/Triclopyr Siteprep
1994 Ground Glyphosate Siteprep
1995 Planting
1995 Ground Glyphosate Release
1996 Ground Hexazinone Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
1996 Ground Glyphosate/Triclopyr Siteprep
1996 Ground Glyphosate Siteprep
1997 Planting
1997 Ground Glyphosate/Triclopyr Release
Release Treatments
1994 Ground Glyphosate/Triclopyr Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
1994 Ground Hexazinone Release
1995 Interplant
1995 Ground Glyphosate/Triclopyr Release
No Action
mile
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MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN

Alternative 4: Maintain conifers and control competing vegetation on existing deeptilled and planted areas. No herbicides.

This alternative calls for release in 1994 of 3,944 acres in deeptill, in addition to releasing 164 acres that have naturally regenerated. Release would occur by hand grubbing a five foot radius around the seedling. Of that amount, 1,781 acres would be released again by hand grubbing the following year:

Table II-9 Treatments by Stand for Alternative 4

Compartment	Stands Hand Released in 1994 Only	Stands Hand Released in 1994 and 1995	Acres (1994)	Acres (1995)
Murphy Peak	16,22,23,25-32,35,36, 37,38,41,42,44,48,49		132	
		8,9,17,38,39	52	52
Cottonwood	17,27,28,31,39,43,45, 46,49		164	
		None		
Matsen	20,21,24,25,26,27,29, 31-45,48-54		391	
		21,22,29,30,31	53	53
Bear Springs	102,106		3	
		3-28,30,34,35,39-51, 56,62,70,72,73,76,79, 81-84,86-89,92,94-103, 105-112,116-121,138,140	926	926
Paper Cabin	None	13,17,19,20,22,23,25, 27,28,30,32,33,36,37, 38,39,41,47,48,49,50, 111,115,116	300	300
Walton Cabin	2,5-11,13,15-22,24-32 38,50,53-66,68-76,78, 87-96,98-103,105, 105,106,108,110,112, 120,127,128,129,131, 139-147,149,151-159, 161,162,163,165,166, 167,169-184,202, 203,211,212,213,215, 219,222,238,239,242, 243,250,259,260,261, 262,266		1,469	
		1,2,13,14,15,45-48,50, 51,101,102,106,107, 111,113-115,121-125, 130-135,137-141,147, 148,234,235,236,251, 253,261	450	450
Totals			3,940	1,781

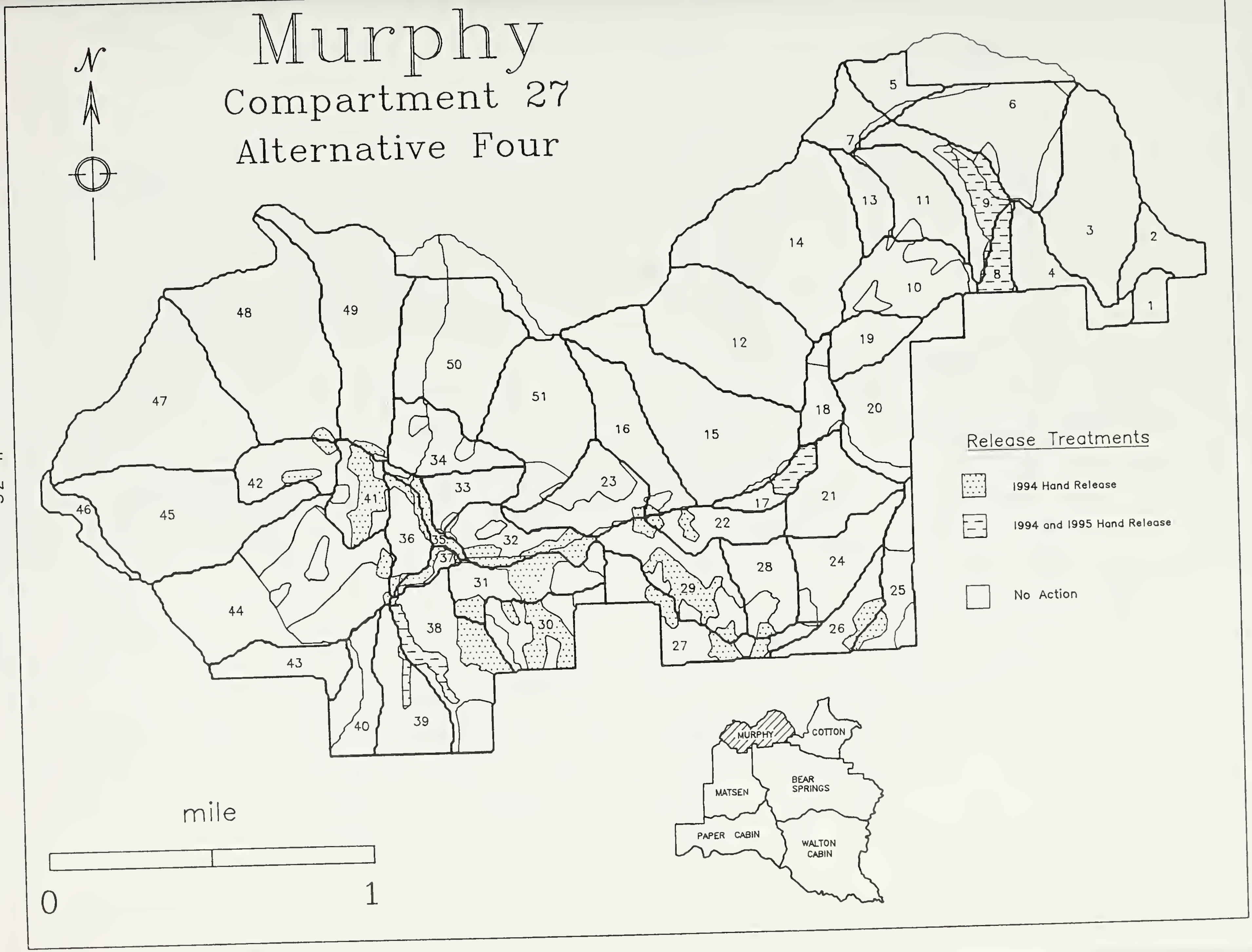
Broadcast burning would not be used as a site preparation method, unlike Alternatives 1-3. However, from 1994 through 1997, burning is scheduled in 2,205 acres-worth of stands outside areas planned for reforestation.

This alternative does not prescribe treating acres by emphasis since activities are limited to hand releasing areas that have already been deeptilled and planted.

Table II-10 **Acres of Treatment by Year for Alternative 4**

Treatment	1994	1995	1996	1997
Hand Release	3944	1781		
Fuel Reduction Burning	209	778	798	420
Plant				
Interplanting				

Treatment maps for Alternative 4 are on pages II-36 through II-41. They show proposed treatments by compartment and stands.


Murphy
Compartment 27
Alternative Four
N
Release Treatments
1994 Hand Release
1994 and 1995 Hand Release
No Action
mile
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MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN
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5
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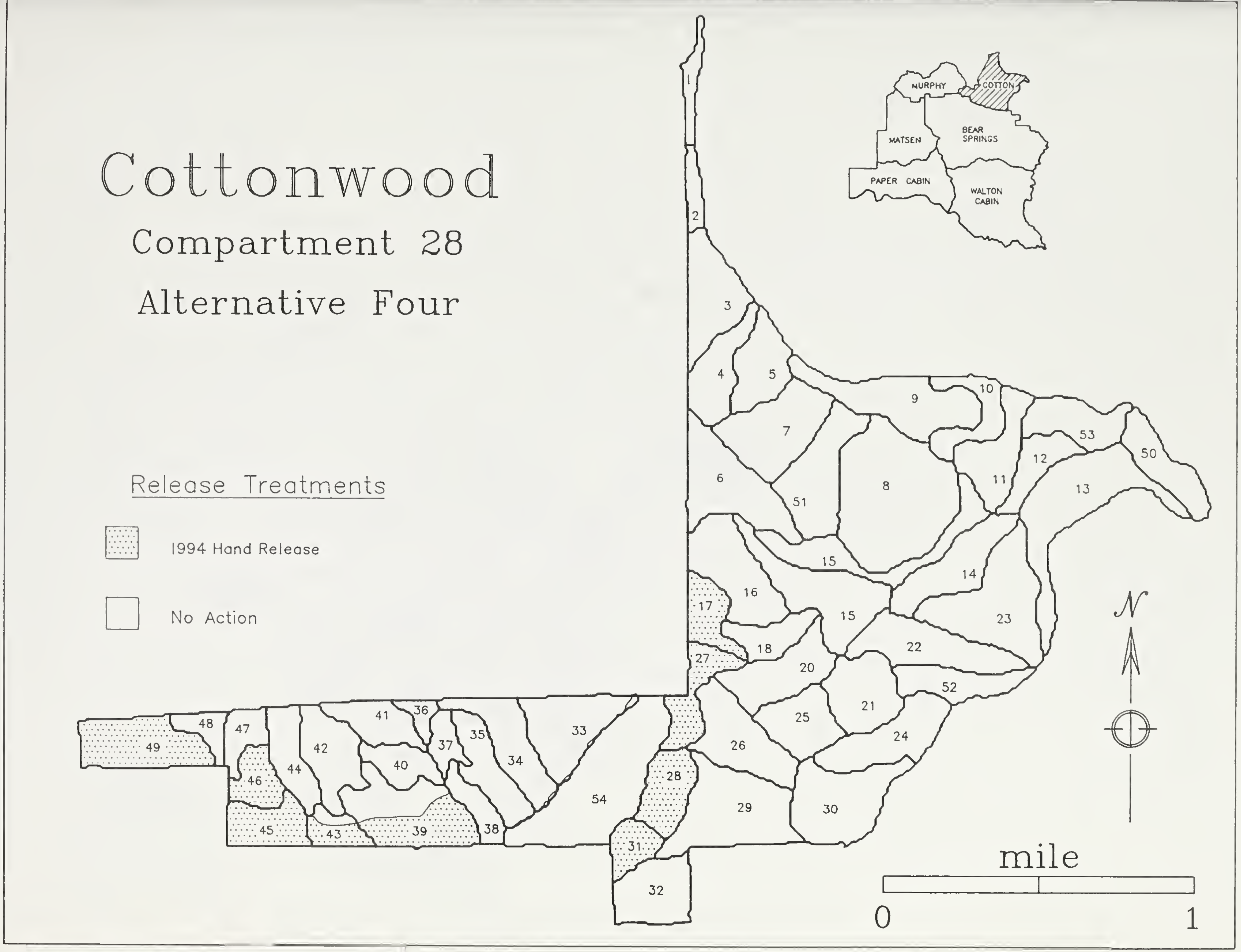
Cottonwood
Compartment 28
Alternative Four
Release Treatments
1994 Hand Release
No Action
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN
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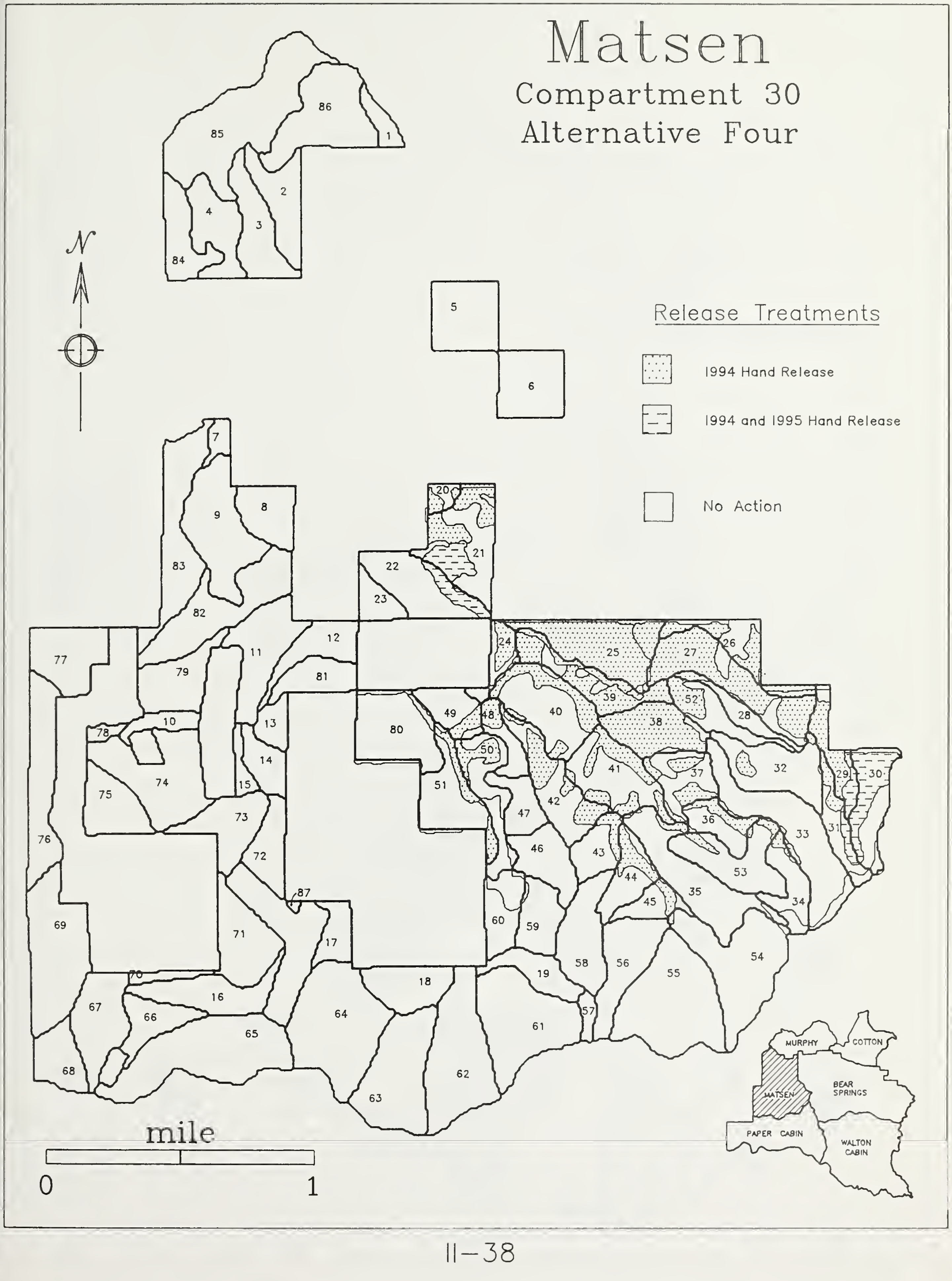
Matsen
Compartment 30
Alternative Four
Release Treatments
1994 Hand Release
1994 and 1995 Hand Release
No Action
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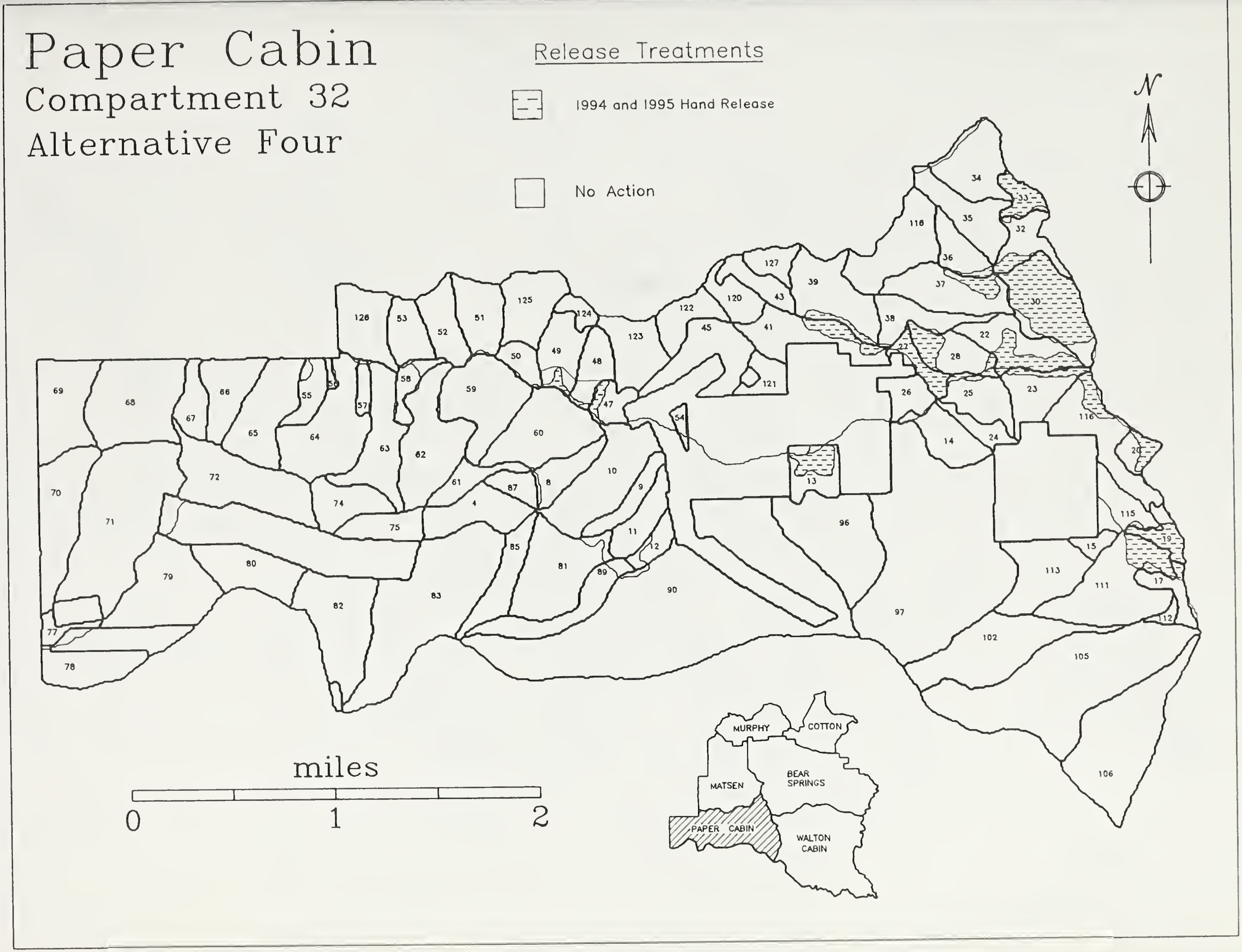
MURPHY
COTTON
BEAR SPRINGS
MATSEN
PAPER CABIN
WALTON CABIN

Bear Springs
Compartment 31
Alternative Four



Paper Cabin
Compartment 32
Alternative Four
Release Treatments
1994 and 1995 Hand Release
No Action
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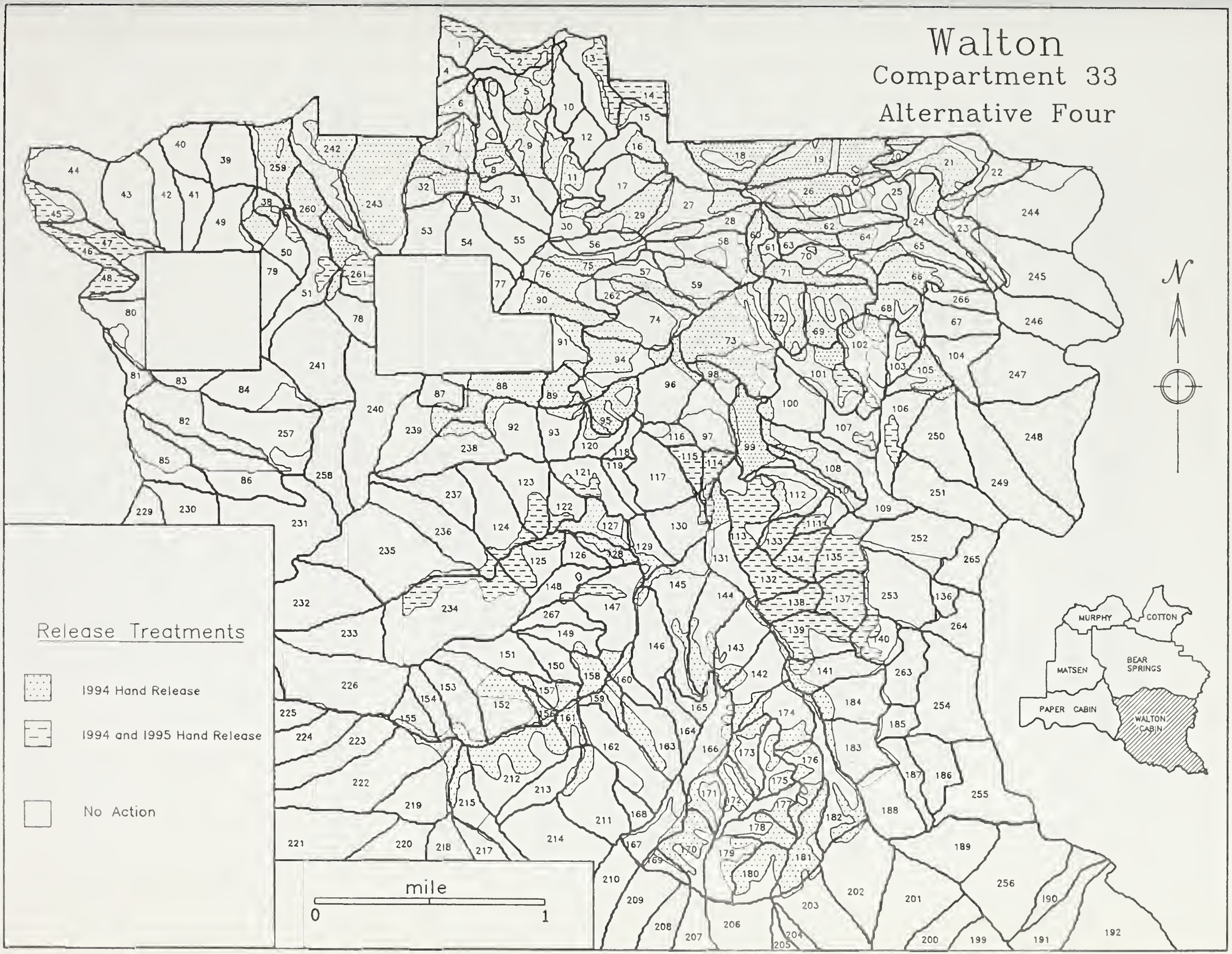
MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN


Walton
Compartment 33
Alternative Four
N
Release Treatments
1994 Hand Release
1994 and 1995 Hand Release
No Action
mile
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MURPHY
COTTON
MATSEN
BEAR SPRINGS
PAPER CABIN
WALTON CABIN

Alternative 5: No Action. No conifer planting or resource recovery activities would occur, and all existing reforested areas in the project area would be abandoned.

This is the "No Action" alternative in which no acres would be planted, interplanted, site prepped or released.

B. Alternatives Eliminated From Detailed Analysis

Extend the conifer reestablishment period from 4 years (Alternatives 1-5) to 30 years.

This alternative was discussed by the IDT and eliminated from detailed analysis.

Under this alternative, optimum horizontal vegetation diversity would occur by staggering planting over 30 years. This could benefit wildlife, scenic quality and biodiversity. However, recovery of resource values would be accomplished in Alternatives 1-4.

This alternative is not considered in detail because the IDT considered the areas that would not be reforested during the 30 year period as contributing little to overall resource management. None of the key issues represented by IDT members would benefit from delayed reforestation, and the cost of not reforesting outweighed any perceived benefits. The IDT felt that diversity would be created by several proposed activities under the alternatives considered in detail. Those activities include: Fuel break maintenance and establishment; retention of oak aggregations; planting of mixed conifer species (where appropriate); decreased planting in all, or parts of, low soil productivity areas; natural recovery in selected low-site timber producing lands or high-value amenity areas; and the potential for early commercial thinning or harvest, which would contribute to a vertically diverse appearance.

Manage for long-term soil productivity by emphasizing oak management on specific stands

This alternative would have prescribed intensive oak management at 36 sqft/acre in sensitive soils areas to increase organic matter and build long-term soil productivity. However, these objectives are incorporated into each of the alternatives by conifer planting and wildlife emphases that prescribe intensive oak management.

Site specific activities, treatments and emphases for each stand by alternative and year are on file at the Mi-Wok Ranger District. Those activities and treatments have also been described in detail in the "Treatment Scenarios" tables and "Treatment Activities" maps in this chapter.

C. Management Requirements and Mitigations

Management Requirements are control measures developed and complied with to prevent adverse effects. Mitigation measures are typically applied to offset adverse effects created by project activities. (Refer to R5-FEIS, Table 2-7, pp. 2-30 through 2-35, for a summary of laws, policies and mitigation measures). As described in this section, these mitigation measures are a part of the alternatives.

Consistent with this document, management requirements and mitigations are categorized by resource. Within each resource, they are listed by alternative. In addition, the project adheres to the Best Management Practices (BMPs) contained in the Forest Plan standards. BMPs are pollution control measures developed and documented cooperatively between the California Water Quality Control Board and the Forest Service.

Air Quality

For Alternatives 1 through 4:

The following mitigations and measures are based on the Federal Clean Air Act, as amended, the 1988 California Clean Air Act, and the air quality standards and guidelines in the Stanislaus National Forest Land and Resource Management Plan. Direction for implementation was derived from reports produced by the Pacific Northwest Research Station Fire Effects Program, Seattle, Washington, the California Air Resources Board and fuels treatment practices utilized on the Stanislaus National Forest. The effectiveness of these mitigations was also demonstrated by monitoring as part of the Little Moss Fire Salvage Project on the Groveland Ranger District, Stanislaus National Forest.

1. Protect visibility in the Emigrant Wilderness and Yosemite National Park.

    a. Adhere to the Clean Air Act, which provides stringent protection for these Federal Class 1 airsheds.

    b. Burn during times when smoke is carried away from or well above these areas.

    c. Do not burn during high visitor use periods.

2. Use Best Available Control Measures (BACMs) to reduce PM_{10} particulate matter.

    a Reduce the amount of pollutants per unit mass of material burned and per unit treated or both. This may include limiting the amount of material burned, shortening the smoldering period or increasing combustions efficiency by using backing fires or pile burn or both rather than broadcast burn.

    b. Dilute smoke concentrations by staggering ignitions, dispersing them over an area, burning during weather conditions that disperse and mix smoke, and cooperating with other persons and agencies to reduce burning time and space.

c. Make on-site observations, conduct quantifiable monitoring and provide feedback to project managers.

d. Ignitions would be staggered over time and space to reduce the rate of release of emissions over the area.

Fire and Fuels

The following mitigations apply to Alternatives 1-4:

The broadcast burning would reduce fuels and provide protection for reforested areas. Maximum fire size objectives for the areas identified to be broadcast burned is 10 acres each, as outlined in the Forest Plan (LMP, IV-39, Table IV-2). The effectiveness of this mitigation was monitored in the Wright's Creek Plantation Underburn of 1991-1993.

1. A burn plan will be prepared at the time of execution of broadcast burning, including "brown and burn" activities in Alternatives 1 and 2. The plan will describe all objectives concerning soil type, intensity of burn, duration and amount of fuel consumed, erosion and nutrient loss, and streamside management zones. Burn plan objectives will include the attainment of overall groundcover (protective soil cover) target levels specified in the Forest Plan.

Heritage Resources

The practice of avoiding cultural resource sites would be implemented in the project area activities sites, and has been demonstrated as effective on the Stanislaus National forest. This practice is provided for in the Memorandum of Understanding Between the USDA, Forest Service, Pacific Southwest Region, Stanislaus National Forest and California State Historic Preservation Officer Regarding Compliance with Section 10G of the National Historic Preservation Act for Timber Management Undertakings That Will Not Effect Historic Properties, dated September 23, 1988, Historic Preservation Officer; and the Advisory Council on Historic Preservation Regarding the 1987 Fire Recovery Program in the Pacific Southwest Region, dated June 3, 1988.

For all alternatives:

1. Heritage resources are protected under the National Historic Preservation Act, Section 106. This applies to historic and prehistoric sites and recognition of Native American values and traditions.

For alternatives 1 through 4:

1. Cultural resource surveys are complete. (LMP, IV, pp. 36 and 37).

2. Identified sites are left undisturbed unless it is impossible to do so. In that case, the property is evaluated for its eligibility to the National Register of Historic Places (NRHP). If the property is eligible, the effects on the property are determined, and compliance with Section 106 of the NHPA completed to mitigate the adverse

effects. If the property is ineligible, the Forest Service attempts to mitigate, but maintains the option to remove the property from further management.

3. Presently used Native American collection areas would not be directly impacted by this project. Existing uses would be able to continue unimpaired.

Human Health and Safety

To provide adequate health and safety protection to both the public and workers involved in herbicide applications, the following site-specific management activities are required for the alternatives containing herbicide application treatments. These were implemented recently for the Paper Cabin Release project, and proved to be effective.

1. Worker Safety:

    a. Minimum protective clothing needed, unless specified otherwise on the label, include boots, long sleeve shirts and pants, and gloves.

    b. When mixing and loading triclopyr, use rubber gloves, rubber aprons and face shields in addition to boots, longs sleeves shirt and pants.

    c. Extra clothing needed when ground applying triclopyr are rubber gloves and goggles.

    d. Provide clean water and soap. Workers must wash with soap and water before eating or smoking.

2. Public Safety

    a. Inspect site for presence of people before spraying. Notify everyone within one quarter mile radius at least one half hour before spraying.

    b. Restrict re-entry into treated areas as per label.

    c. Avoid applications to roads and trails.

    d. Post temporary public safety signs.

3. Public and Worker Safety

    a. Adhere to the following BMPs: BMP 5.8 (Pesticide-Use and Planning Process), BMP 5.9 (Pesticide Application According to Label and EPA Registration Directions, BMP 5.10 (Pesticide Application Monitoring and Evaluation, BMP 5.11 (Pesticide Spill Contingency Plan), BMP 5.12 (Cleaning and Disposal of Pesticide containers and Equipment), BMP 5.13 (Streamside and Wet Area Protection Zone During Pesticide Spraying) BMP 5.14 (Controlling Pesticide Drift During Application)

Range

The following mitigation applies to alternatives 1-3:

1. Inspect area before spraying and remove livestock from project area if herbicide label restricts grazing.

2. Plan salt, water, bedding and fencing locations to draw livestock away from project activities.

3. Control livestock grazing use season.

These practices are expected to reduce exposure to the livestock.

Recreation/Scenic

The following applies to Alternatives 1-4:

1. To protect recreation values, a silviculturist and landscape architect will design project activities to minimize impacts in the following popular sites: Indian Springs (Walton Cabin Stand 24), Walton Cabin (Walton Cabin Stand 172), and Hunter Crossing (Bear Springs Stand 104).

Soil

Consistent with Soil quality Standard monitoring demonstrated as effective on the Stanislaus National Forest, the following effective practices would be implemented as part of this project:

The following mitigations apply to Alternatives 1-4:

1. Bandarita-Mariposa has a thin surface layer of nutrients and organic matter. To mitigate adverse effects to this sensitive soil, landscape, the following measures would be taken:

    a. Soil cover, after broadcast burning, would meet the standards contained within the Forest Plan.

    b. Increase habitat for micro-organisms and maintain nutrients by retaining, when available, a minimum of 5 logs per acre in the 16 inch size class (LMP, p. IV-75).

2. Monitor soil for persistence and accumulation of herbicides and conditions of key soil characteristics (refer to Appendix 3, Soil Monitoring Plan).

Vegetation/Sensitive Plants

As discussed in the Biological Evaluation (Appendix M), the following practices which have proved effective on the Mi-Wok Ranger District will be used in this project to effectively prevent federal listing, or loss of viability, of Sensitive Plants:

Sensitive Plants:

Of the four Sensitive plant species which may occur on the Mi-Wok Ranger District, only one, the Tuolumne fawn lily (*Erythronium tuolumnense*), may potentially be found within the project units. The three other Sensitive plant species are *Allium tribracteatum*, *Lomatium stebbinsii* and *Silene invisa*; suitable habitat for these species is not contained within the project units.

The Tuolumne fawn lily is protected during all reforestation and recovery phases. Current management guidelines prohibit herbicide use in any population during the critical growing period (March, April and May). Surveys are complete for the area regarding potential population sites. (Refer to LMP, p. IV-76).

All known populations are flagged and protected from treatments with mechanical equipment, road construction, herbicides or other potentially damaging physical or chemical factors. Refer to the management guide for the species for specific coordination guidelines.

Alternatives 1-3: (In areas where fawn lilies have been identified):

Apply foliage and soil active herbicides by directed spot treatments rather than as broadcast spray treatments. This applies to ground applications.

Alternatives 1-2: (In areas where fawn lilies have been identified):

Prohibit aerial applications of soil active herbicides.

Alternatives 1-4 (In areas not previously identified as having potential populations of fawn lilies):

Survey all drainages that have not been surveyed before starting vegetation management practices.

Riparian Habitats:

The following mitigations have been implemented and proven effective in other projects within the National Forest:

Riparian habitats exist in Bear Springs Compartment stands 28, 29, 30, 31, 32, 34, 35, 37, 38, 65, 66, 71, 76, 77, 78, 79, 80, 122 and Walton Cabin Compartment Stands 9, 30, 31, 55, 75, 76, 77, 90.

Alternatives 1-3 (Herbicide applications):

Buffer strips, as described in each alternative, would be used.

Alternatives 1-4:

1. Leave snags greater than 15" dbh in riparian zones on perennial or intermittent streams. Manage for down logs according to in-stream log require-

ments on fishery streams. On intermittent streams, provide one down log 20 feet or longer by 25"-44" in diameter, in addition to the forest-wide standard.

2. Leave snags to meet Forest Plan minimum requirements (LMP, pp. IV-175-176).

3. Revegetate riparian areas as soon as possible with an appropriate mix of conifer species. Replanting these important water and wildlife areas is a high priority and tiers to the Forest Plan (LMP, pp. IV-90-91).

Segments of the 11 miles of perennial and 27 miles of intermittent streams within the project area burned intensely enough to prevent rapid natural recovery. These segments were surveyed to determine riparian recovery needs.

Specific segments expected to have riparian recovery treatments include Hunter and Grapevine Creeks, as follows:

TABLE II-11 RIPARIAN RECOVERY: HUNTER AND GRAPEVINE CREEKS

			Riparian Revegetation Needs	
Stream Segment #	*Compartment*	*Stand #*	*Conifers**	*Hardwoods***
HUNTER CREEK				
1	Bear Spr.	31,32,37	Yes	Yes
	Bear Spr.	34,35	Yes	
2	Bear Spr.	28,29,30,31,37, 77,78,79,80	Yes	Yes
3	Bear Spr.	79,82,83,84,85, 88,89,91	Yes	Yes
4	Bear Spr.	35,45,46,47	Yes	Yes
5	Bear Spr.	34,35,41,43	Yes	Yes
6	Bear Spr.	43,44,53	No	
7	Bear Spr.	25,26,28,29,71, 76,77,104	Yes	Yes
8	Matsen	31,32,33	Yes	Yes
	Matsen	32,33,37,38,52	Yes	
9	Matsen	42,43,46,47,48	Yes	Yes
GRAPEVINE CREEK				
1	Walton Cbn	56,78	No	
2	Walton Cbn	75,90	No	Yes
3	Walton Cbn	118,119,120,121	Yes	Yes
	Walton Cbn	92,93,120,121, 123,238	No	
4	Walton Cbn	125,126,140,150, 234,267	No	Yes

* Where indicated "yes", conifers in the riparian areas burned severely and no natural regeneration is occurring or expected to occur soon. These areas should be replanted as soon as possible.

** Hardwoods include alders, willows, big leaf maples, and dogwoods. Where indicated "yes," resprouting occurred shortly after the fire. This project does not include planting hardwoods.

Water Quality

Increases in runoff efficiency and delivery of sediment and chemical constituents to surface waters are processes which have the potential to create adverse effects on water quality. The Best Management Practices described in this chapter and the following mitigations have proven to be effective in preventing off-site transport of sediment and chemical constituents to stream channels and surface waters when implemented on previous projects within the National Forest.

The following mitigations apply to Alternatives 1-4:

1 Implement the Forest Plan Streamside Management Zone (SMZ) policy (LMP, Streamside Management Zones 18-C, pp. IV-84--85). This governs allowable disturbance and ground cover requirements in SMZ's. It also provides direction for reforestation efforts in streamside corridors.

2. Implement R5 Soil Quality Standards, as specified in the Forest Plan (LMP, pp. IV -75--76; Appendix J). These standards indirectly help protect water quality by reducing the amount of soil compaction and erosion thus minimizing the potential for increased runoff and sedimentation caused by management activities.

3. Apply BMP's for Water Quality Maintenance, as site specifically refined for this project. (Refer to R5-FEIS for a full listing of the water quality BMPs).

Wildlife/Fisheries

As recommended as effective in the Biological Assessment and Biological Evaluation (Appendix 3) for preventing Federal listing, or loss of viability, of wildlife species, the following practices shall be implemented:

For all alternatives:

1. Spotted Owl: Restrict mechanical and aerial operations from the 0.25 mile buffer zone around California Spotted Owl activity centers from March 1 through August 15 (California Spotted Owl Sierra Province Interim Guidelines Environmental Assessment, US Department of Agriculture, USFS, 1993, p. II-2). This may be modified by a wildlife biologist if ground conditions show that more or less distance is needed.

2. Goshawk and Great Gray Owls: Protect active nests from potentially disturbing activities from March 1 until at least four weeks after the young have been fledged, or September 30 if the fledging date has not been determined for a particular nest, for a distance of at least 0.3 miles. Specific nest sites are unknown (Refer to Chapter 3). This may be modified by a wildlife biologist if ground conditions indicate more or less distance is needed.

3. Provide thermal and hiding cover for mule deer by retaining 36 sqft/acre oaks in areas of critical winter range, shown in individual alternatives emphasis maps in this chapter. Consult a wildlife biologist and consider fuel management needs when removing cover.

The following mitigations apply to Alternatives 1-4:

1. Provide thermal and hiding cover for mule deer by retaining non-sawtimber and larger tree (dead and alive) within and next to green islands and all perennial and intermittent streamside management zones. Consult a wildlife biologist and consider fuel management needs when removing cover.

2. Retain non-sawtimber and larger trees (dead and alive) for mule deer thermal and hiding cover on perennial and intermittent streamside management zones and within and adjacent to green islands. Consult a wildlife biologist and consider fuel management needs.

3. Leave all snags greater than 15" dbh in riparian zones on perennial or intermittent streams, and in green stands.

Leave snags in all other areas to meet the Forest minimum management requirement of 1.2 snags/acre, 15-24" dbh; and 0.3 snags per acre, at least 25" dbh (LMP, IV, pp. 175 and 176).

Leave down logs in compliance to the Forest Plan (LMP, pp IV-176).

4. To protect riparian habitats:

Leave snags according to Wildlife Mitigation #3. In riparian areas on intermittent streams, provide one down log 20 feet or longer by 25"-44" in diameter, in addition to the forest-wide standard.

See Water Quality Mitigations.

The above mitigations apply to riparian habitats in Bear Springs Compartment Stands 28, 29, 30, 31, 32, 34, 35, 37, 38, 65, 66, 71, 76, 77, 78, 79, 80, 122; and Walton Cabin Compartment Stands 9, 30, 31, 55, 75, 76, 77, 90.

5. To protect species that depend on oak:

Do not damage or remove oaks with living crowns that survived the 1987 fire (this does not include resprouting oaks that have living roots but dead crowns from the fire). Manage activities to minimize any incidental damage to oak and other hardwoods, whose above ground portions survived the 1987 fire. This applies to all treated stands in all alternatives.

6. To protect fishery streams:

Leave snags as described in Wildlife Mitigation #3.

Provide in-stream large woody material (down logs) consistent with standards and guidelines found in the Forest Plan (LMP, IV,p.50). This applies to all stands in any alternative along Hunter, Grapevine, and Bear Springs Creeks.

See Water Quality Mitigations.

Water Quality Best Management Practices

The following Water Quality Best Management Practices (BMPs) are requirements and must be adhered to in this project. BMPs are specific mitigation measures for water quality. However, they also mitigate impacts on fire/fuels, health and safety, vegetation, and wildlife and fisheries.

BMPs are listed sequentially rather than by resource. BMP mitigations tier to the LMP (pp. IV-83-84, Management Practice 18-A, first two paragraphs of Standards and Guidelines).

BMP 1.8 - Streamside Management Zone Designation (Alts 1-4)

When conducting thermal reforestation practices, maintain a SMZ of 100 feet on perennial streams, 50 feet on intermittent streams and 25 feet on ephemerals.

SMZ widths may be adjusted by project managers based on recommendation of a hydrologist, fisheries biologist, or a wildlife biologist.

Within the SMZ, maintain a minimum of 70 percent ground cover density. Ground cover means a minimum of 1 inch of duff or litter, rock fragments or live plants less than five feet tall.

BMP 5.8 - Pesticide-Use Planning Process (Alts 1-3).

The Forest Soil Scientist and Forest Hydrologist are members of the ID team, and they:

Evaluated soil and watershed responses to the proposed herbicide applications and provided criteria for identifying sensitive areas to be avoided or needing additional protection.

Developed site-specific monitoring plans for soil and water quality at sensitive sites (refer to Appendix 2).

BMP 5.9 - Pesticide Application According to Label and EPA Registration Directions (Alts 1-3).

Before contract award, the contractor shall have a current State of California Agriculture Pest Control Operator License. The Contractor shall:

Register his/her State License with the Tuolumne County Agriculture Commissioner before any spraying.

File a use report with the Contracting Officer to verify rates per acre.

Comply with the State of California Safety Orders found under the California Administration Code.

Batch herbicides in the presence of the Contracting Officer or Representative. The Contacting Officer or Representative will be on the project site to monitor and evaluate the herbicide application.

Provide at least one qualified or certified individual for each mixing truck, to handle fueling, mixing and loading. Mixing and loading is done in areas where accidental spills will not cause contamination of water, food, stocks or crops.

Provide a qualified supervisor trained to take remedial action in event of equipment malfunction, herbicide or carrier mix spills.

Do not apply hexazinone where it is expected to enter ground or surface water, such as when soils are very sandy or have low clay or organic matter contents.

Soil samples will determine organic matter and texture for hexazinone application rates as specified on the herbicide label.

Herbicide prescriptions are site specific for each stand. They are detailed on Stand Record Cards on file at the Mi-Wok Ranger District office and in Treatment Scenarios tables in this chapter.

Several stands within the project area contain very sandy soils or soils with low clay or organic matter contents, as defined by label requirements of herbicides with hexazinone (Velpar L, Pronone) as the active ingredient. Strictly follow prescriptions restricting hexazinone application. The following stands (refer to Chapter 3) will exclude broadcast hexazinone application. Spot applications at least 15 feet from wells and springs is still allowed. This reduces/ eliminates potential ground water contamination.

Compartment	Stands
Murphy	30, 31
Paper Cabin	17, 20, 22, 23, 30
Walton Cabin	4, 6, 7, 61, 63, 70
Bear Springs	16, 18, 19, 49

BMP 5.10 - Pesticide Application Monitoring and Evaluation (Alts 1-3).

The project will be evaluated within 6 months of treatment, by the Soil Scientist, Hydrologist and Silviculturist to assess project effectiveness and the effectiveness of safety and resource protection measures.

Treatments are monitored and evaluated during application by the Contracting Officer or Representative (Appendix 2). Colorants are used for ease of inspection and to assure application only on target vegetation. The Contractor shall be required to:

Give the Tuolumne County agriculture commissioner a Notice of Intent.

Complete and file all use reports, with a copy to the Contracting Officer.

Complete any other incidental requirements.

BMP 5.11 - Pesticide Spill Contingency Plan (Alts 1-3). The following measures help prevent any spills from occurring:

Store all unattended herbicide concentrate under lock and key in its original container.

Travel on designated routes as shown in the contract package. This applies to all herbicide carrying equipment.

Batch herbicide in the presence of the Contracting Officer. The Contracting Officer or Representative designates the batching location a safe distance from streams and springs. The batch tank and any herbicide containers remain at the approved batching location.

Draft water only into containers (water truck) that are clean and never contained pesticides. Closely match the amount of herbicide mixed at any one time to the volume needed on individual units. This assures a minimal amount of mixed batch moves between units.

Prepare a Spill Plan before any herbicide application. This details containment and notification measures should a spill occur.

Require a spill kit on all vehicles carrying herbicide containing:

- A minimum of 25 pounds of absorbent material such as cat litter.
- Two 30 gallons, 4 mil polyethylene garbage bags with ties.
- Two shovels.

Take immediate action, if a spill occurs, to contain the spill. As soon as possible the Contractor will notify the Contracting Officer Representative or the Forest Dispatcher.

BMP 5.12 - Cleaning and Disposal of Pesticide Containers and Equipment (Alts 1-3). All herbicide containers shall be:

Triple rinsed, with clean water, on the work site approved by the Contracting Officer. Containers and equipment are not washed in or near streams, rivers, or lakes.

Rinsed in conformance with California Code of Regulations, Subarticle 10 Section 6684. The rinse water shall be disposed of by placing it in the batch tank and applying it to the vegetation on the unit.

Punctured on the top and bottom to render them unusable after rinsing.

Recorded as to how they were rinsed and where they were disposed. This shall be kept by the contractor and made available to the Contracting Officer.

Disposed at a certified approved dump site (conforming with California Code of Regulations, Subarticle 10 Section 3142) before final contract payment.

Contractors are not permitted to camp on the National Forest. This reduces potential water contamination from workers bathing or rinsing equipment while camping.

BMP 5.13 - Streamside and Wet Area Protection Zone During Pesticide Spraying (Alts 1-3). Buffer strip widths and location for each stand are determined by the Forest Hydrologist as part of the water quality monitoring plan for this project.

The Contracting Officer inspects during herbicide application. Colorants indicate herbicide swath and coverage.

The Contractor shall use only government designated water sources and it is required that a clean water tank with a back flow prevention device be used.

Identify buffer strips before herbicide treatment. Buffer zone widths are as described in the alternative descriptions.

BMP 5.14 - Controlling Pesticide Drift During Spray Application (Alts 1-3)

Strictly follow all EPA and State approved herbicide labels.

Use spray nozzles which produce large droplet size at low pressures. A TEEJET XR 80-04VS is an example of this type of nozzle.

Equip ground sprayers with an in-tank or in-line pressure regulator allowing a 30psi maximum nozzle pressure.

Use low volatility formulations and adjust equipment to minimize drift. Calibrate spray equipment in the presence of the Contracting Officer or Representative before and during work by the Contractor.

Add a water soluble colorant to herbicide to aid visual monitoring of spray placement and drift.

Monitor weather conditions before and during herbicide applications to prevent drift, volatilization, leaching, or surface runoff of herbicides. Stop operations under any of the following conditions:

Wind velocity exceeds 6 miles per hour.

Raining or rain imminent for glyphosate and triclopyr.

Weather that produces enough moisture on the plant surface to reduce the ability of the herbicides to adsorb onto the surface.

Temperature exceeds 85 degrees Fahrenheit when using triclopyr.

Temperature inversions that could lead to off site spray movement when using triclopyr.

Use the following procedures during aerial applications (Alternatives 1 and 2):

Turn applicator off at the end of a swath and during turns before starting another swath. Initial spray swaths along buffer strips or other areas to be protected are made parallel to these areas and when the wind is blowing away from the area.

Maintain helicopter speed at 50 miles per hour or less and at the lowest safe height above the ground.

Provide radio network linking all parts of the project. Maintain direct radio contact between spray aircraft and ground crews.

Make preapplication reconnaissance flights to orient pilots to project boundaries, buffer zones and other sensitive areas.

Avoid aquatic systems and residences during helicopter flights.

Provide maps showing treatment and loading sites, and site features in application plans.

BMP 6.3 - Protection of Water Quality from Prescribed Burning Effects (Alts 1-4)

Consult with a soil scientist and/or hydrologist in formulating burn prescriptions for thermal reforestation activities.

Maintain a minimum of 70 percent ground cover density in SMZ's if burns are conducted in these areas.

Maintain an SMZ where applicable when conducting thermal reforestation activities.

Avoid intense fires which may bare too much soil and thus more easily allow erosion and sedimentation.

Water bar firelines as needed.

BMP 7.6 - Water Quality Monitoring Plan (Alts 1-3). The intent of water quality monitoring is to meet applicable water quality objectives in the Water Quality Control Plan (Basin Plan) of

the California Central Valley Regional Water Quality Control Board, and to comply with water quality antidegradation policies of the federal government (40 CFR Ch.1, Section 131.12) and the State of California (Water Resources Control Board Resolution 68-16). Timely reporting of monitoring results go to the Central Valley Regional Water Quality Control Board for their determination of compliance with objectives and policies. If in compliance, the project may continue; if not, it will be adjusted so that objectives and policies are met.

Prepare a Water Quality Monitoring Plan for this project each year during project implementation.

Analyze water quality samples for herbicides (glyphosate, triclopyr and hexazinone), sediment and other applicable water quality parameters.

Sample each year for the duration of the project and for the following two years.

Collect baseline water quality samples in the spring before the project begins.

Conduct water monitoring during operations, during post-treatment stormflow runoff and during subsequent low flow periods.

Ensure the monitoring plan contains at least the following provisions relating to herbicides:

Monitor surface water immediately at or below selected areas of (a) herbicide application, (b) downstream beneficial uses of water and (c) watersheds exiting the project area.

Monitor storm runoff and baseflow at an adequate frequency and for a period long enough to determine the quantity and persistence of herbicides in water.

Monitor water at selected sites before herbicide application to determine background levels.

Monitor to determine quantity, trend and persistence of herbicides in water. This includes such techniques as automated instrumentation, hydrograph analysis and collection of flow-proportional samples.

Provide periodic feedback to project managers to determine if water quality objectives are being met.

Manage project operations so that water quality objectives are achieved.

Note: An herbicide water quality monitoring protocol, which provides direction for the site specific monitoring plan, is included in this document. Refer to Appendix 2.

D. Alternatives Comparison

The table on the following page presents a summary comparison between the alternatives. It addresses how each alternative meets the project objectives that were discussed in Chapter I, Section H, "Objectives."

Table II-12 - Comparison of Alternatives by Objectives

Project Objective	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt.5
1. Meet SNFLMP Timber Objectives					
Projected Yield:	456 MMBF	416 MMBF	391 MMBF	47 MMBF	N/A
2. Meet Deer Winter Range Needs					
a. Acres with 36 sq. ft. of Oak	758	2,467	2,374	N/A	N/A
b. Acres with 20 sq. ft. of Oak	0	862	807	N/A	N/A
c. Cover:Forage Ratio	93:7 Low Quality	63:37 High Quality	60:40 High Quality	51:49 High Quality	28:72 Low Quality
3. Meet other Non-game and Game Wildlife Habitat Needs					
a. Gray Squirrel					
Acres of Habitat	3,444	3,680	3,680	5,000	6,075
Numbers	2,860	3,680	3,680	5,000	6,075
b. Mountain Quail					
Acres of Habitat	1,100	3,930	3,930	7,650	10,930
c. Whiteheaded Woodpecker Pairs					
No. after 40 yrs.	460	361	361	230	116
d. Old Growth Dependent Birds					
Number of Pairs after 75 years:					
Pileated Woodpecker	36	26	26	14	3
Goshawk	2	2	2	1	1
Spotted Owl	4	3	3	2	2
e. Trout Recovery Rate	high	high	high	medium	low
f. Fisher and Red Fox					
Capability after 75 years	low	medium	medium	low	low
4. Meet Water Quality Standards	Meets	Meets	Meets	Meets	Meets

Project Objective	Alt. 1	Alt. 2	Alt. 3	Alt. 4	Alt.5
5. Encourage Riparian Species					
Reforestation next to Damaged Riparian Areas (linear miles)	3.8	3.8	2.9	0	0
6. Maintain Soil Productivity	Meets	Meets	Meets	Meets	Meets
7. Utilize Cost and Time Efficient Methods					
Total Cost per acre	$569.09	$569.09	$668.80	$573.37	N/A
Cost per acre for Vegetation Control	$371.47	$371.47	$481.38	$573.37	N/A
Number in Site Prep/Release Administration Crew	5	5	5	1	N/A
Average Acres/Day for Site Prep (1 ten person crew)	89	89	40	N/A	N/A
Average Acres/Day for Release (1 ten person crew)	46	46	40	.75	N/A
Total Time Needed	355 days	355 days	562 days	5,259 days	N/A
8. Enhance Scenic Values					
Percent of FS land Reforested with Conifers	40%	35%	33%	14%	4%
9. Reduce Fuel Concentrations					
Acres of Broadcast Burn	3,332	3,332	2,661	2,205	0

III. AFFECTED ENVIRONMENT

Chapter III describes the existing environment and resources in the project area that would be affected by implementation of the alternatives. The environment description serves as the baseline for comparisons in Chapter 4, Environmental Consequences. Chapter 3 covers resources in the same order that they appear throughout the document.

General Physical Setting

The Paper Reforestation and Recovery Project is located on the Mi-Wok Ranger District of the Stanislaus National Forest, Tuolumne County, California. Geographically, the project area lies in the central Sierra Nevada, roughly north of the Tuolumne River, west of the Clavey River, east of the North Fork of the Tuolumne River and south of Basin and Cottonwood Creeks.

Annual precipitation is about 35-45 inches; of which approximately 80 percent occurs during the November through April wet season. Elevations range from about 2,500 feet near Paper Cabin Ridge to 5,835 feet at Duckwall Mountain. Steep slopes are common within the project's middle elevation range.

Areas proposed for reforestation in this analysis are located within six resource management compartments: Matsen, Murphy Peak, Cottonwood, Paper Cabin, Walton Cabin and Bear Springs Compartments. The legal location of these compartments includes all or portions of T1S, R17E, Secs 2, 3, 4, 5, 6, 8, 9, 10, 11 MDM; T2N, R16E, Secs 5, 26, 34, 35, 36, MDM; T1N, R16E, Secs 1, 2, 3, 10, 11, 12, 13, 14, 15, 16, 21, 22, 21, 24, 25, 26, 27, 28, 29, 32, 33, 34, 35, 36, MDM; T2N, R17E, Secs 28, 32, 33, 34, MDM; T1N, R17E, Secs 3, 4, 5, 6, 7, 8, 9, 10, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23, 26, 27, 28, 29, 30, 31, 32, 33, 34, 35 MDM; T1N, R16E, Secs, 1, 2, 3, 34, 35, 36; T2N, R16E, Secs 27, 26, 25; T2N, R17E, Sec 30; T1N, R17E, Sec 31 (refer to Chapter I-11 to I-16).

The combined acreage of all six compartments is 40,403. Of that, the project area encompasses 36,059. Within the project area, 28,345 is National Forest and 7,714 is private property. Thirty-four people own private property within the area. There are no right of way conflicts. Reforestation would occur on up to 11,770 acres of National Forest that are capable, available and suitable for reforestation. A minimum of 15,700 acres within the District would not be treated, and would be left to recover naturally, including the inner gorge, the green area and substantial non-capable, available and suitable land.

Overstory species include Douglas fir (*Pseudotsuga menziesii*); ponderosa pine (*Pinus ponderosa*); sugar pine (*P. lambertiana*); incense-cedar (*Libocedrus decurrens*); white fir (*Abies concolor*); black oak (*Quercus kelloggii*); interior live oak (*Q. wislizenii*); and brewer oak (*Q. breweri*).

Understory species identified from Stand Record Cards and post burn inventories include bearclover (*Chamaebatia foliolosa*); poison oak (*Rhus diversiloba*); deerbrush (*C. integerrimus*); *Ribes spp.*; whiteleaf manzanita (*Arctostaphylos viscida*); black oak and live oak (*Quercus spp.*); Pacific dogwood (*Cornus nuttallii*); California nutmeg (*Torreya californica*); toyon (*Heteromeles arbutifolia*); bracken fern (*Pteridium aquilinum*); and various grasses, legumes and forbs.

The major competitors with conifer seedlings are bearclover, manzanita, deerbrush, grasses and forbs.

The following describes the existing condition of the affected environment by resource:

A. Air Quality

The proposed project area is within the Mountain Counties Air Basin (MCAB) of California. The MCAB consists of nine contiguous Sierran counties from Plumas to Mariposa, and represents a common air mass. The Air Pollution Control District of Tuolumne County Health Department has the legal responsibility of enforcing compliance with air quality standards.

The California Air Resources Board (CARB) designates "burn" and "no burn" days, which regulate all open burning in the state. Burn plan permits are required prior to burning. The Air Pollution Control Officer (APCO) is the regulating official. Due to a lack of air quality monitoring data in the MCAB, the majority of the air basin, including the proposed project area, remains "unclassified" regarding accountability.

Within 12 miles easterly and northeasterly are two federal Class 1 airsheds, the Emigrant Wilderness and Yosemite National Park. Class 1 airsheds are designated in the federal Clean Air Act to receive the most stringent protection from air quality degradation (LMP, p. III-23). Essentially, these are pristine airsheds and intended to remain so.

Visibility is an important value in the Class 1 airsheds near the project area. Protection of visibility is a requirement of the federal Clean Air Act for these watersheds and is currently being monitored in the Emigrant Wilderness and Yosemite Valley. Visibility monitoring cameras take daily photographs which are analyzed to determine "standard visual range." In general, visibility is very good in these Class 1 airsheds.

The project area is part of a federal Class 2 airshed. Air quality in the project area and surrounding airsheds is generally very good and is much better than in the adjacent San Joaquin Valley. Most of the year the air is very clear. Impacts do occur, however, to air quality in and around the project area; haze from pollutants in the San Joaquin Valley occasionally reach this area. Smoke from wildfire and prescribed burning also affects air quality.

This proposed project has the potential to affect air quality in the form of smoke emissions from prescribed burning.

B. Economics

Forest management activities affect the human as well as the natural environment. They affect individuals and groups of people living within the National Forest's immediate sphere of influence (defined as counties within which the Forest lies), and those residing in the Forest's extended sphere of influence (defined as the geographic location of National Forest user groups other than local residents). (LMP, p. III-2).

In the case of the Stanislaus National Forest, the immediate sphere of influence includes Alpine, Calaveras, Mariposa, and Tuolumne Counties. It is the residents of these affected counties who are most directly affected by National Forest management activities.

The National Forest's extended sphere of influence includes the northern San Joaquin valley (primarily Stanislaus and San Joaquin Counties) and the San Francisco Bay area. These residents comprise the vast majority of regional recreational users of National Forest lands who are affected, indirectly, by National Forest land management activities.

Population growth and migration patterns in the impact area have significant implications for project planning. For example, rapid growth, in general, places strain on local infrastructure including roads, schools, police, fire protection, social programs and waste disposal.

Roads and schools are partially funded by Forest Receipt Act payments. These payments largely depend on timber harvest levels. Pressure could occur to maintain or increase harvest levels to fund necessary road and school expansion.

More people create increased pressure for subdivision and development on the National Forest fringe. This increases the potential for management conflicts, and demand for fire suppression services.

Most new residents come from outside the local area, mainly from urban rather than rural areas. They may have different beliefs and expectations about National Forest management than do long-time residents; the contrast may be most evident in their perspectives of the balance between different uses of the National Forest, particularly regarding the relative importance of timber harvest. Newcomers are less likely to be involved with logging, sawmill operations or livestock grazing. Therefore, they are less likely to be sympathetic to traditional commodity uses when conflict occurs between residential and recreational uses.

Many new county residents are older than the median age of the state population, reflecting the county's popularity as a retirement area for urban residents. New residents are more likely concerned with recreational and aesthetic amenities offered by the National Forest rather than with job-producing economic aspects, such as the timber harvest.

New residents, however, may change their perspective after becoming more acquainted with the relationship between traditional uses of the National Forest and local benefits provided by those uses. Examples of benefits include personal use fuelwood cutting; wildland fire protection; maintenance of National Forest system roads; revenue to counties for roads and schools; and local employment income that directly supports retail, amenity and service oriented-local business.

The Stanislaus National Forest contributes to the regional economy in two primary ways: Generation of income and employment opportunities for residents of the immediate area; and direct and indirect contributions to local county revenues.

The Forest also contributes to the regional economy in secondary ways, such as the procurement of goods and services in the local area and production of commodities that are consumed in local and regional markets.

Although some economic effects are dispersed over a broad area, the most important effects are felt in Alpine, Calaveras, Mariposa and Tuolumne Counties.

The two employment sectors most affected by the proposed project are the timber industry and tourism. Effects are difficult to quantify, both in terms of total employment and relative importance to the local economies of the four affected counties, since state and federal sources of employment data do not break down data into these two sectors.

In Tuolumne County, 1990 U.S. Bureau of Census figures show 1,757 jobs in the manufacturing sector, of which 776 were in agriculture, forestry and fishery.

The importance of tourism is vital to the local economy. In 1991, revenues from the tourism industry totaled $202,129,000.00, according to a report prepared by Dean Runyan Associates (April, 1993) for the California Trade and Commerce Agency. The report also stated that 2,893 people were employed on a full-time basis in the county's tourism industry, or 23.6 percent of total county employment. The figure includes seasonal winter employment at Dodge Ridge and the following subsectors: hotels and motels, eating and drinking establishments, food stores, auto service stations, recreation and amusement services and miscellaneous retail sales. Tourism was second only to government as the largest overall employer of Tuolumne County residents.

National Forest contributions to county revenues come from three sources: Payment of in-lieu taxes, timber yield taxes and Receipt Act Payments (LMP, p. III-13).

Receipt Act Payments are the most significant in terms of total contributions to each county, and are the ones most likely to be affected by reforestation decisions. Although Receipt Act Payments to counties comprise annual collections from grazing, land use, recreation, power, minerals and admission/user fees, timber sale receipts make up about 90 percent of the total.

National Forest contributions to county revenues vary widely from year to year because they are based on timber yield and harvest levels. During the period from 1982 through 1986, the Forest provided: Revenue payments to Tuolumne County ranging from 2.5 percent to 5.4 percent (average about 3.9 percent) of the total county budget; and $4,832,886 to Tuolumne County for roads and schools.

Overall, the social economic environment within the impact counties for the proposed project includes five general groups of people. These social groups are described here for the purpose of general analysis. Individual opinions may vary widely within, and among, these user groups; some individuals may fall within several of the analysis groups or may not be adequately represented by these groupings. The analysis groups are defined as follows:

Regional Commodity Interests. This group (LMP, p. III-10) is economically tied to the National Forest through employment, or ownership of lumber, pulp and paper mills or other secondary processing plants in adjacent counties and/or in the central valley. The lifestyle of this group depends on steady, high levels of commodity outputs from the forest, particularly timber.

Since this group values commodity outputs most highly, and may not live or recreate in the immediate forest environment, amenities such as scenery and wildlife habitat are generally considered less relevant. If the provision of amenities interferes with commodity production, members of this group may become sensitive to variations among the alternatives proposed for this project.

Long Time Residents. Long time residents (LMP, p. III-8) also place high value on the National Forest's ability to provide commodity outputs with its associated higher local employment. However they also tend to support dispersed recreation activities such as hunting, fishing and fuelwood gathering. Generally speaking, economic and commodity uses of the forest have higher priority for long time residents than do amenities such as scenery and wildlife habitat.

Native Americans. Native Americans (LMP, p. III-10), as a group, tend to relate to the forest in a fashion similar to other long time residents of the area. Their livelihoods depend on National Forest commodity outputs, particularly timber production, and they use the forest for traditional recreational activities such as hunting and fishing. Although these individuals value the forest's ability to provide

jobs and income, they are also highly sensitive to Native American ceremonies and traditions which took place, and may still take place, in the forest environment.

Additionally, the National Forest contains many archaeological sites that have social, cultural and religious significance to the local Native American community. Reforestation activities may alter cultural sites.

Newcomers and Second Home Residents. This group (LMP, p. III-9) includes a high number of retirees and others who moved to the foothills to escape the pressures of urban life and to enjoy a quieter lifestyle oriented more to the natural world. For the most part, members of this group do not directly depend on forest commodity outputs for jobs. They are interested in seeing the visual recovery of the burned area, especially as it relates to dispersed recreation opportunities.

Forest timber yield and harvest partially supports: The lifestyle of new residents, who indirectly benefit from Receipt Act payments to the county for partially funding community services, such as schools and roads; and local retail, service and amenity businesses enjoyed by this group. Some of these businesses are partially supported from income produced by timber related jobs.

Regional Recreationists. Regional recreationists (LMP, p. III-9) have an important relationship to the Forest, but do not live in the local counties. Rather, they reside in the Forest's extended zone of influence, primarily the Central Valley and San Francisco Bay area. Regional recreationists use the high quality recreation attractions on the Forest for a wide variety of activities. This group is diverse in its beliefs and values, and can be divided into two reasonably distinct groups by type of recreation activity: Developed-site and motorized users; and dispersed area, non-motorized users.

Developed -site and motorized users are attracted to the more developed types of activities, including developed-site camping, downhill skiing, automobile travel for scenic viewing and off-highway vehicle use. Scenic quality, quality recreation experience and amenity values such as good fisheries are important.

Primitive camping, backpacking, hiking, river-rafting and cross-country skiing are the main activities among dispersed area, non-motorized users, who hold a broader set of amenity values than other recreationists. Their interest is in wilderness and wild river preservation, the maintenance of unroaded areas and wildlife habitat protections as well as scenic quality. These values are often extended to the Forest as a whole, rather than limited to the immediate area of use.

Local and Regional Environmental Group Members. For the members of this group, the protection or preservation of the natural and amenity attributes of the Forest is of prime importance, whether or not they actually experience those attributes. Many belong to national environmental organizations such as the Sierra Club and Audubon Society, and look to these organizations to represent their views (LMP, p. III-10).

This group values a wide range of amenity values. This group is interested in the preservation of biodiversity and the overall sustainability of the forest ecosystem.

C. Fire/Fuels

Fire is a natural force of change in all the ecosystems of the project area. Fire will continue its historical role of vegetation removal and regeneration. Fire size and intensity depends, to a large degree, upon forest management activities.

The 1987 Stanislaus Complex Fire consumed about 75 percent of the available fuel from the forest floor. Prior to the fire, this fuel, consisting of duff and woody material, helped stabilize the soil and suppressed brush seeds embedded in the soil. The fire's removal of the duff layer reduced, and in many areas eliminated, any fire hazard for the short term, 1 - 3 years.

However, a new fuel bed, receptive to fast and intense fires, has resulted from post-fire emergency grass seeding for soil stabilization. Grasses are dense with other vegetation sprouting up through the grass layer. Additionally, the few remaining snags will eventually fall to the ground, creating a worse fire hazard than what existed before the 1987 fire. The resulting fuels will be more continuous, with little diversity, setting the stage for high rates of fire spread through highly flammable fuel beds. A more favorable fuel situation allows fires to spread through diverse fuels with broken-up continuity.

This area has had a large fire about every thirty years since 1900. Smaller fires have occurred on a ten year cycle and remained small due to fuel diversity. High fuel loading and continuity coupled with similar weather conditions as existed in September of 1987 could generate large wildland fire.

Based on Mi-Wok Ranger District fire ignition records, the project area's fire occurrence history is two lightning and two human-caused fires per year (a 60-year average). The annual lightning-fire frequency is 0.125 fires per 1,000 acres. Expected lightning fires are above the historical average of two per year; actual numbers will depend upon the amount of fire killed timber (snags) left standing.

Current objectives are to stop 90 percent of wildfires before they reach 10 acres in size. About 10 percent of the wildfires will exceed 10 acres because of extraordinary circumstances.

Destructiveness is related to fuel loading. In an area with low fuels, a fire will often "underburn" a stand, leaving most trees alive. In a high fuel area, a fire can "crown out," destroying all trees.

Fuel Loading. Fuel loading is dynamic, highly variable and difficult to predict over time. The use of comparative, standardized models helps determine fuel conditions. The Northern Forest Fire Laboratory has standardized reference models for fuel types and their resultant fire behavior. Anderson (1982) describes these in a pictorial format.

The representative fuel model for this project area is Fire Behavior Fuel Model 8. This fuel model has a thin layer of twigs and needles that fell from damaged or killed trees. This typically results in 5 tons per acre of fine fuels that would carry a fire. This fuel type presents suppression difficulties only under the most extreme weather conditions.

Current fuel loading in green islands is variable due to the complex fire history and the varying degrees of intensity of recent fires. Fuel loading in the green islands ranges from 17 to 62 tons per acre. Green islands in the project area are Model 10. This fuel type typically contains about 12 tons of fine fuel per acre. Large diameter fuels may increase the fuel loading. Wildfire in this fuel type is difficult to fight directly, in all but the most favorable weather conditions.

Fuel loading in fire salvaged and biomassed areas is as low as 10 tons per acre but averages about 20 to 40 tons per acre.

In summary, project area fuels have changed since the 1987 fire, and continue to change through time. The current average Fuel Model 8 will eventually change to a more hazardous Fuel Model 10; this process can be affected by taking measures to create a diverse fuel condition. Reforestation, if well planned and implemented, will help to create the desired condition.

Fuelbreak System. A completed fuelbreak system, consisting of about 50 miles, or 1186 acres, exists in the proposed project area. Fuelbreaks are located in the following stands:

Paper Cabin Compartment: 3, 8, 9, 10, 12, 13, 17, 19, 20, 22, 23, 25, 27-31, 33, 38, 39, 41, 47-55, 57-61

Walton Cabin Compartment: 1, 2, 13-15, 18, 27, 28, 39, 40, 42-46, 48, 57-59, 61, 68, 69, 71-74, 80, 81, 85, 86, 96, 97, 99, 104, 105, 114, 122-131, 139, 141-145, 147, 152-161, 174, 176, 182-184, 188, 189, 259

Bear Springs Compartment: 58, 60, 61, 64, 67, 88, 97-100, 102, 106-108, 110-112, 116, 117, 120, 140

Murphy Peak Compartment: 17, 18, 20-23, 31, 32, 37, 38

Fire Behavior. Potential future fire behavior depends on seasonal variations in climate, summer rains, humidity, fuel moisture, wind speed and direction, temperature, and the amount, size, and arrangement of ground fuel. These factors, except fuel conditions, vary from year-to-year and even from day-to-day. The following potential fire behavior discussion focuses on fuel loading changes. These changes become more significant as weather conditions favor fire ignition and spread.

Potential near-term fire behavior has been reduced, compared to before the 1987 fire. As time passes, fuel loading and fire potential will increase due to the deterioration of dead trees and the accumulation of large amounts of ground fuel from fallen needles and limbs. High snag density, and their broad dispersion, contributes to potential long-range fuel loading. Increased snag density in the area increases the likelihood of lightning caused fires.

Fire behavior predictions for various fuel models (Table 3-1) are based on typical late summer afternoon weather conditions in the proposed project area:

TABLE III-1: FIRE BEHAVIOR PREDICTIONS PER FUEL MODEL

Fuel Model	Rate*	Size**	Containment***
8	3	0.1	yes
5	13	1.3	no
11	10	0.7	?
10	10	0.8	?

* Rate = Forward rate of spread measured in chains per hour through a continuous fuelbed.

** Size = Projected size after 1/2 hour if the weather, fuels, and topography remain constant for this period and that no suppression efforts occur.

*** Contain = The 10 acre containment test is an assessment whether initial attack forces in sufficient numbers, could get to the fire in time to contain the fire at 10 acres or less. Yes, No or Questionable (?).

D. Heritage Resources

The affected environment includes 113 cultural properties which have been identified within the area. Inventory is complete on all of the proposed stands, most taking place since 1987 in support of the fire salvage effort and subsequent biomass projects. The 113 sites cover an estimated 110 acres. About 75 percent of these sites fall within proposed reforestation areas. The cultural resource inventory is complete for all the proposed stands.

Prehistoric Native American Use. The proposed project area's western boundary is the North Fork of the Tuolumne River. The southern boundaries are the Tuolumne and Clavey Rivers. Basin Creek bounds the project's northern end. Major drainages such as Hunter Creek and Duckwall Creek traverse portions of the area. These stream courses played an important role in the lives of prehistoric people of this area, as water was often the focal point for hunting, fishing, and habitation.

This area was inhabited by the Central Sierra MeWuk. The MeWuk generally lived in semi-permanent villages and traveled, seasonally, into the higher country to hunt, fish and gather plant material. The MeWuk consumed a wide array of plant material, most importantly the acorn. They also ate greens, bulbs, grass seeds, nuts and berries. The project area was well suited for these resources, especially for black oak. Black oak was the preferred type of acorn (Moratto 1981:19). Fishing was important for those living nearer the larger drainages.

Common site types include bedrock milling stations and artifact scatters. Bedrock milling stations represent food processing areas. Artifact scatters consisting of lithic debitage and/or portable groundstone represent work sites for tool manufacture and food processing. These sites were most likely used as seasonal camps for food procurement and processing, and hunting. Many sites may have been occupied on a repeated seasonal basis, as indicated by midden deposits and housepits.

Deer traps (long V shaped brush fences), brush fences (for trapping quail), and nets used to trap rabbits were reportedly located just west of the Matsen Compartment. References to these features date from the 1930's (Barrett and Gifford 1933). These features most likely no longer exist, but their mention supports recent archaeological findings that indicate that this portion of the project area received heavy use by the MeWuk.

Early accounts describe a number of MeWuk villages in the vicinity of the Matsen and Walton Cabin Compartments (Moratto 1981:39, 41). Two steatite quarries (Barrett and Gifford 1933:211) are reportedly located near the western edge of the project area; the location of these quarries is unknown.

Sixty nine of the 113 sites are prehistoric, and there are an additional 6 sites which contain a prehistoric component. Of these 75 sites, it is unknown how many are nominated to the National Register or are significant. The prehistoric site breakdown is as follows:

> 86 percent contain artifact scatters and/or bedrock milling stations
>
> 12 percent contain midden deposits and/or possible housepits in addition to artifact scatters and bedrock milling stations

There is also one rockshelter/cave, which overlooks one of the major rivers. It is typical of others found in similar environments throughout the Central Sierra Nevada. This rock shelter may have functioned as a dwelling, bedrock milling station and storage area; it probably played an important role to hunters during seasonal deer migration.

Historic Use (1820's - present). The historic sites found within and immediately adjacent to the project area reflect the general use of the Forest. After an initial period of exploration and trapping in the 1820s and 1830s, the dominant uses of the project area were mining, water development, ranching, and railroad logging.

There are 38 known historic sites recorded within the project area. An additional 6 sites contain an historic component. The resources found that reflect mining activity include shafts, adits, pits, hydraulic cuts, tailings and associated historic era artifacts. Ditches, flumes and dams supported the mining and domestic uses in the area. Ranching became an important activity in the 1850's; evidence includes structures, fencelines and domestic debris (tin cans, glass etc).

Railroad logging took place between 1903 and the 1960s. The Westside Lumber Company (operated until the 1960s) constructed lines for accessing timber in and around the project area. Railroad logging camps located along the tracks now consist of structure remains and assorted debris. Constructed trails also served for travel and may be associated with many of the historic activities.

One historic fire lookout (Duckwall Mountain) lies within the project area.

Contemporary Native American Use. Although no consultation has occurred regarding the proposed project area in specific, consultation did occur in the fall of 1987 immediately after the fire. Archaeologists met with the American Indian Council of Mariposa County to inform them of the Forest's plans for salvaging fire damaged timber and rehabilitation efforts. One concern expressed at this meeting was that the increased site visibility and increased access might lead to more site vandalism.

In December, 1987, a professional Forest Service archaeologist accompanied a local MeWuk from the Tuolumne Rancheria to a number of places on the MiWok Ranger District. These areas are currently used by Native Americans; some use areas fall within the project area. Based on information from that field trip, the following collection areas exist in the general project area:

> Eight traditional acorn (black oak) collecting areas. These are still used by members of the local Indian community, especially in conjunction with Native American religious ceremonies
>
> Two wild mushroom collecting areas
>
> Two California nutmeg (*Taxaceae californica*) collection areas. California nutmeg is a room air freshener
>
> One wild onion collection area
>
> Four traditional hunting areas (for deer and wild pigeons)

Other concerns and information from the MeWuk:

> Access to traditional collecting areas is now more difficult due to locked gates during early spring and late fall, the critical collecting time
>
> Hunting and acorn collecting are more difficult, resulting from type conversion from mature forest/oak woodlands to conifer-dominated reforested areas.

Information regarding two prehistoric sites and four historic sites. The prehistoric sites involve springs, and the historic sites include a sawmill, two mines and a cabin. Local Native Americans worked in the sawmill in the early part of this century. The cabin was used in the 1920s and 1930s for cattle ranching.

Ongoing communications with the Tuolumne Rancheria contributes information and Native American concerns specific to the Paper EIS.

E. Human Health and Safety

The areas proposed for treatment are near, or within, parts of the Stanislaus National Forest that are used for dispersed recreation. These recreation activities include hiking, hunting, camping, firewood gathering, fishing, off-road vehicle or mountain bike use, and berry gathering. This use is relatively light, however, due to the combination of high summer temperatures, relatively poor road access in the winter, and the sparsity of key destination spots. There are no hiking trails known to exist in the stands to be treated and overall hiking use is low due to the above factors.

Use associated with deer hunting may be the single largest source of public activity. Even this, however, may only attract about 200 people/year. Dispersed camping, in undeveloped campsites such as Hunter Crossing, Indian Springs and Walton Cabin, as well as along roadsides, may amount to another 200 people. Firewood cutting in the area is very minimal due to the overall lack of supply, which was depleted soon after the fire salvage work was completed.

An estimated 80 people live within one-quarter mile, 10 people within one eighth of a mile, and 6 people live adjacent to a proposed treatment boundary. These estimates are derived from the Tuolumne County land ownership maps, and assistance from fire prevention and law enforcement personnel that conduct residence inspections, traffic counts, and personal experience.

The site-specific risk assessment in Appendix 1 examines the potential health effects on all groups of people who might be exposed to the three herbicides proposed for use in Alternatives 1, 2 and 3. Those at risk fall into two groups: the members of the public mentioned above and workers. Workers include applicators, supervisors and other personnel directly involved in the application of the herbicides.

The most likely individuals to be exposed to herbicides during and after this project are backpack applicators, contract inspectors, residents who live near the treatment areas and visit the sites, grazing permittees, and members of the public who also visit the treated sites.

The members of the public could be exposed through contact with sprayed vegetation, drift of the herbicides, eating food items such as berries growing in or near treated areas, eating game or fish containing herbicide residues, or by drinking water that contains such residues (R5-FEIS, Appendix F, page F-1).

For the most part, the backpack applicators are non-local. Crews generally work for contractors who have successfully bid on Forest Service reforestation projects. These crews travel over wide geographic areas as they complete work for the Forest Service and private land owners. The crew size needed to complete this project within the effective treatment window is estimated to range from a minimum of 5 to a maximum of 30 individuals.

F. Range

In all alternatives, the entire project area is located within either the Duckwall or Hunter Creek allotments.

Duckwall allotment consists of approximately 17,470 gross acres, including 9,749 acres of national forest and 7,721 acres of private land. Depending on the alternative, between 512 and 1,651 acres of the allotment fall within the project area to be treated. The allotment includes two term grazing permits totaling 180 cow/calf pairs.

Hunter Creek allotment consists of approximately 30,410 gross acres, including about 27,145 acres of national forest. Depending on the alternative, between 10,279 and 3,338 acres are within the project area and would be treated. Hunter Creek allotment has no term grazing permit and is classified "vacant." For the 1993 grazing season the District Ranger issued a temporary permit for part of the allotment. The allotment contains 125 cow/calf pairs.

G. Recreation/Scenic

The entire proposed project area is a variety class B landscape (LMP, p. III-146), which is typical of the Sierra Nevada and characterized as moderately varied terrain, vegetation and waterforms. The area appears more monotonous, however, due to the 1987 Complex Fire's hot burn and the few surviving trees.

Along with variety loss, many manmade features are now seen that were previously screened by vegetation. Roads, terraces, skid trails, constructed firelines, and landings are now only partially screened by the remaining dead tree stems, grass, and emerging new growth. Over time, these factors alone, without planting, will soften the unnatural appearance of the existing manmade alterations.

The Forest Plan sets goals for changes resulting from management activities, called Visual Quality Objectives (VQO's). VQO's are categorized into four classes: Preservation, Retention, Partial Retention, Modification and Maximum Modification (LMP, III-147). Each VQO describes a different degree of acceptable alteration of the natural landscape based upon the importance of aesthetics. Preservation prohibits management activities. There are no stands classified Preservation. Retention allows activities which are not visually evident. In Partial Retention, activities may be noticeable, but must remain visually subordinate to the surrounding landscape. The project area's VQO (Visual Quality Objective) is largely Modification, meaning that disturbances can be apparent. Most of the project area is seen only from roads within the burn area that receive light recreation use.

Portions of the area are viewed from the Cottonwood Road (1N04) at close distances. The following stands have a VQO of Retention:

Cottonwood Compartment: 39, 43, 45, 46, 49

Murphy Compartment: 8, 10, 19, 48, 49, 51

The distance between the seen landscape and the viewer is divided into three zones: Foreground, middleground and background. The foreground distance zone represents the area where individual details of the landscape can be discerned (0-1/2 mile). The middleground distance zone represents the area where individual details cannot be discerned, but patterns are obvious (1/2-3 miles). The

background distance zone represents the area beyond middleground where only major features are obvious (3-5+ miles) (LMP, III, 147).

The following stands are greater than 1/2 mile from the Cottonwood Road or the Tuolumne area and have a VQO of Partial Retention.

Murphy Compartment: 16, 18, 20, 23, 32, 33, 34, 35, 38, 39, 41, 42, 44

Bear Springs Compartment: 6, 7, 8, 54

Matsen Compartment: 5, 7, 9, 22, 23, 24, 49

The proposed project area receives relatively light recreation and there are no developed recreation sites. Hunter Crossing, Indian Springs, and Walton Cabin are the only locations of concentrated recreation use. No Forest Service-maintained trails are in the area. Most users enjoy the area's remote rugged terrain, hunting, and the absence of other users.

Low elevation supports a long use season. Temperatures are hot during the summer, but very favorable during the spring when much of the Forest is inaccessible due to snow. Logging roads provide opportunities for Off Highway Vehicle (OHV) users; the absence of vegetation due to the fire left many areas vulnerable to OHV damage.

H. Soil

The *Soil-Vegetation Survey for the Duckwall Conflagration Control Project* (1970), on file at the Mi-wok Ranger District, contains a detailed inventory of soil/vegetation landscapes within the project area. The survey describes the project area as a Conifer-Hardwood-Shrub ecosystem. This detailed soil/vegetation inventory helps managers to design the future forest after a major wildfire. The affected environment for soils is based on this information, and fieldwork done following the 1987 fire.

The Conifer-Hardwood-Shrub ecosystem consists of three soil landscapes named after the dominant soil series. The three soil landscape units in the project area are: Bandarita-Mariposa, low site; Mariposa, medium site; Josephine-Mariposa-Sites, high site.

Higher quality sites, such as the Josephine-Mariposa-Sites landscapes, are more robust and resilient to impacts of reforestation because they have the following characteristics:

Substantial amounts of nitrogen and organic matter in the mineral soil.

Deep, well-drained soils that are more stable and less affected by erosion.

Favorable climatic conditions.

Rapid secondary succession by a variety of plants that reestablish the nutrients and organic matter cycles.

Lower quality sites, such as the Bandarita-Mariposa Landscapes, have:

Less total nutrient and organic matter, which vulnerable to losses by burning.

Shallow, or gravelly rocky soils that reduce nutrient and moisture storage capacity.

Steep south-facing slopes that are more vulnerable to mechanical and fire damage. Fires on these slopes are hotter and create greater erosion potential.

Soil landscapes are linked to reforestation potential (Klock, G.O. 1983). Lower quality landscapes are more fragile, and have a slow natural recovery rate.

Bandarita-Mariposa landscape: This landscape occurs on 20 percent of the project area, on broad rounded ridgetops and shoulder slopes where the subsoil is a dense clay that is difficult for conifer roots to penetrate. The Mariposa soils are a Mariposa, dry phase. Mariposa, dry phase, south aspect soils typically have little to no topsoil. Within this landscape, conifers and black oaks are often concentrated in drainages where moisture is more available. Buckbrush and oaks are common and contribute to high wildlife values. Considering brush competition and potential wildfire is very important when designing a future forest in this landscape.

Soil Capability and Reforestation. The Bandarita-Mariposa soil landscape is the most fragile because of its low organic matter (OM) due to low biomass production. Fire would create a high erosion rate. Soil building is limited due to low moisture content. This landscape benefits from soil improvement practices that build organic matter and minimize site disturbance.

Beginning in 1987, fieldwork has notes the differences in soil development under oaks, conifers, and manzanita within this landscape. In burned and unburned areas the topsoil is commonly more strongly developed under oaks than it is under pine or manzanita. The decomposed litter layer is often thicker, topsoil color is darker, and granular structure and soil porosity are more developed. Oaks and nitrogen fixing shrubs, such as buckbrush, and non-nitrogen fixing shrubs, such as white leaf manzanita, are an important natural recovery component on this degraded landscape. Recent research emphasizes the need for revegetation of disturbed sites with indigenous host species, such as oak, bearclover and manzanita, and associated beneficial soil organisms (Perry, Molina, Amaranthus, 1987. Mycorrhizae and Reforestation: Current Knowledge and Resource Needs. Canadian Journal of Forest Research 17: 929 - 940).

The following stands contain Bandarita Mariposa soil landscape segments:

Paper Cabin Compartment: 10, 23, 25, 31, 37, 41, 55-60

Walton Cabin Compartment: 1, 4, 5, 7, 9-11, 29, 30, 39, 41-44, 48, 67, 69, 87, 93, 95, 107, 120, 125, 126, 128, 147, 162, 170, 180, 187, 259-261

Bear Springs Compartment: 13, 14, 16, 20, 24, 25, 28, 31, 87, 94, 95, 97

Matsen Compartment: 9, 30, 33, 34, 40, 41

Murphy Peak Compartment: 41, 42

Mariposa Landscape: This soil landscape occurs within 30 percent of the project area. Mariposa soils are deeper and more productive than the Mariposa, dry phase and are typically found on slopes greater than 30 percent. Black oaks may be the dominant species over live oak; populations of incense-cedar, bear clover and sugar pine increase while buckbrush and poison oak decrease on this landscape. Under these conditions the conifer-hardwood-shrub type begins to occupy slopes on all aspects. These sites are suitable for moderate conifer productivity. Where oaks exist, wildlife use is high.

Soil Capability and Reforestation. This soil landscape is more resilient than the Bandarita-Mariposa landscape. Topsoil layers are not as thick as those found on Josephine and Sites soils. Mariposa soils in this landscape are on slopes too steep to treat mechanically and therefore are not at risk from topsoil being displaced by tractor piling of live brush. Low impact practices such as herbicide treatment and crushing are appropriate on this soil type. This soil landscape offers an opportunity to manage black oaks to enhance biodiversity and wildlife values.

Josephine-Mariposa-Sites Landscape: This soil landscape occurs within 50 percent of the project area. The vegetation on the deeper and more productive Josephine and Sites soils includes well stocked stands of ponderosa pine. Minor conifer species include incense-cedar, sugar pine and Douglas-fir on the north facing slopes. Hardwoods consist of black oak and canyon live oak; a dense understory of bear clover and scattered Mariposa manzanita exist on this soil type. At elevations of 4,500 feet, white fir becomes a component on north and east slopes. Conifer productivity is high on this landscape.

Soil Capability and Reforestation. This landscape has resilient, robust and productive soils which are recovering quickly from the burn and will be more resilient to any alterations associated with reforestation. A wider range of reforestation practices is appropriate on this soil landscape, including broadcast burning. Of the three soil landscape units, this landscape is best suited for high timber production and a diverse mix of tree species.

I. Vegetation, Sensitive Plants, and Riparian Vegetation

Of the 36,059 acres in the project area, 7,714 acres are in private ownership, and 28,345 acres are National Forest lands. Of the 28,345 National Forest acres, 3,807 acres are green mature forest, 11,893 are not suitable for conifer reforestation, and 12,645 acres are capable, available, and suitable for reforestation. Since the 1987 firestorm, the Mi-Wok Ranger District has planted 4,675 acres which are at least partially stocked, and 968 acres which failed. Of the planted areas, 895 acres of competing vegetation have already been released and interplanted, and do not need further work in the next few years. Stands and aggregations within stands are discussed in Appendix 4, Compartment Maps and Stand Prescriptions.

Of the 7,970 suitable acres which remain unstocked, 7,299 acres are covered with vegetation less than four feet high, such as grass, bear clover, manzanita, buckbrush and golden fleece. A total of 671 acres are covered with taller vegetation, primarily deerbrush.

Status of Recovery

Deeptilled and Planted Areas (4,675 acres)

Survival of planted trees in the 3,780 deeptilled acres is highly variable. Some areas have very low survival rates, and are no longer considered "fully stocked," especially in the Walton Cabin compartment. Most of these areas have trees which exhibit symptoms of drought stress, such as growth losses, yellowing needles, and premature loss of needles. Already stressed trees may more easily succumb to further damage from insects or rodents.

Initially, deep tilling destroyed or damaged much of the reinvading and resprouting grass, bearclover and brush. However, one year after deeptilling, large amounts of grass reseeded, and two years afterward, brush and bearclover started to sprout, and brush seedlings reappeared. The grass alone is causing continuing stress and mortality of the planted trees, and increasing levels of bearclover and brush are raising the level of competition.

Areas planted in 1989, totaling 895 acres, have been released by hand twice, released by herbicide twice, and interplanted twice, and are predicted to remain stocked in the next few years.

Unplanted with Short Competing Vegetation (7,299 acres)

These areas have not been planted because they are too steep for mechanical site preparation, such as deeptilling. Similar areas were planted in 1989, before competing vegetation grew back; initial survival rates were low (35 percent) even with most of the vegetation in the initial stages of regrowth. It was decided that further replanting without site preparation would result in failures at a high cost. Since the initial attempts at planting, the vegetation has had 5 years to extend root systems through the soil, grow vigorous foliage, and become resistant to damage. Vegetation in these areas includes grass and forbs, bearclover, manzanita, oaks, golden fleece, yerba santa and more. Most of the vegetation is less than 4 feet in height.

Few seed-producing conifers remain within the burned area. Therefore, natural regeneration of conifer seedlings is very limited. In order for natural reforestation to occur in much of this area, trees would have to slowly spread from the few remaining green areas. Since the process of growing through the brush, maturing, and producing seed takes at least 30 years, and the seed would fall within 100 feet of the parent tree, it would take an estimated 400 years for conifers to advance even one quarter mile into the burn. This assumption leaves out probable events such as large fires, insect epidemics, and other destructive natural forces. From these estimates, it becomes clear that natural reforestation could not occur in less than 500 years, and probably would take much longer.

Included in the unplanted acres are 968 acres that were planted without site preparation and experienced almost total mortality. Vegetation in these planted areas is similar to the unplanted areas. Surviving conifers are less than 10 per acre; this is less than 2 percent of full stocking, and less than 7 percent of minimum stocking. The death of most seedlings, and the poor chance of survival for the remainder, made these areas essentially the same as the unplanted areas.

Cottonwood Compartment is located on the edge of the burned area and contains large numbers of seed trees. Conifer seedlings have grown up in the open areas, primarily ponderosa pine and Douglas fir. Although unevenly distributed, there are sufficient numbers of these natural seedlings to consider portions of these stands stocked, approximately 164 acres. However, grass, bearclover and brush are also revegetating the area at a high rate, and competing with the conifers for valuable moisture and nutrients. Most of the area would not meet minimum stocking standards under current conditions.

Unplanted with Tall Competing Vegetation (671 acres)

These areas are unplanted for the same reasons as above. The primary difference is that the vegetation is tall, and usually deerbrush. Deerbrush sprouts profusely, and has already covered these areas with thick 4 to 8 foot tall brushfields. Walking through these areas is difficult and almost impossible in many places. Handgrubbing would be extremely hazardous to workers, because of the high possibility of tripping and falling on a sharp tool. In areas in this condition, ground application of herbicides would be impossible, since workers would be loaded down with heavy, awkward, backpack sprayers, and the elevated angle of spray would be hazardous to workers.

Other Burned Areas (11,893 acres)

All other areas are primarily oak woodland, brushfields, and grassland. Some conifers may be found in these areas, but these are not suitable areas for conifer forest due to poor soils or low elevations. Some mature oaks remain after the fire, and sprouting oaks are growing quickly. High fuels remain in these areas, since burnt oaks were not logged after the fire. The only proposed activity in this area is 2,205 acres of broadcast burning to reduce fuels.

Reforestation Tools. After the 1984 herbicide suspension, current site preparation methods were limited to the hand-cutting of planting strips through dead brush, and mechanical crushing and deep sub soiling (tilling/ripping). Some areas received no site preparation before planting. Manual release entailed hand grubbing a 5 foot radius circle around each seedling. Since the Region Five Vegetation Management Environmental Impact Statement (Feb., 1989) was signed, use of some herbicides, including glyphosate, hexazinone, and triclopyr, is an option.

Factors Affecting Survival and Growth

Vegetation. Trees planted in the burn in 1989 had such low survival (35 percent) that intensive interplanting was needed in 1990 in order to maintain stocking. Competing vegetation was the main cause of this low conifer survival and growth, especially during the drought period when available water is the limiting factor to seedling survival and growth. The key to survival during the summer drought is a plant's ability to "compete" for water, by filling the soil with its roots before other plants do. Grass and brush grow quickly from seed, and bearclover and some brush species such as deerbrush and some manzanitas will sprout after burning. Initially, roots of plants grow more quickly than the stems and leaves. This enables them to "control" an area more quickly by preventing other plants from taking up water. Conifers are not able to grow as quickly, especially since they require higher soil temperatures in order to initiate root growth. In lower elevations, grass and brush may grow for significant portions of the winter, taking up valuable water and filling the soil with their roots before the conifers even get a chance to start growing. Survival of conifers is dependent on either having the growing site free of competition before planting or having the competition controlled afterwards, preferably both. Fibreboard Corporation lands were treated effectively with herbicides, resulting in a 80 to 90 percent survival rate for planted seedlings, plus significant amounts of natural seedlings.

Similar areas on National Forest land were released by hand, resulting in only 27 percent survival of seedlings. Mechanical site preparation in addition to hand release increased survival to 58 percent; all areas suitable for mechanical site preparation have already been treated. See Chart I-3, Survival within the Stanislaus Burn.

After 6 years of growth, brush species such as deerbrush, manzanita, golden fleece, and oaks have recovered so well that hand methods such as cutting and grubbing are very hard due to the strong branches and root crowns. Root systems of brush have recovered and are able to easily sprout back after such treatments. Brush seedlings have also had 6 years to gain a foothold, and increase the numbers of brush plants. Deeptilling, which has been completed on all appropriate areas, can rip most brush out of the ground. However, seed is still present in the ground, and in a few years most brush species can easily revegetate an area. Five years after herbicide treatments, competing vegetation cover ranges from 30 to 60 percent on Fibreboard Corporation lands in the Stanislaus Burn. Glyphosate (Accord or Round-up) and Triclopyr (Garlon 4) are both effective against most brush species, but as the plants grow in size, they are more resistant to treatments. Hexazinone is effective against small plants of all species, but mature oaks are resistant. Based on site investigations, it was observed that roughly 90 percent of oaks survive treatment. Deerbrush grows to heights of 6 to 8 feet; although it is easily killed by hexazinone, the tall stems and branches remain and make walking hazardous and planting almost impossible. In the past, access was improved in similar areas by either burning or handcutting. Handcutting without herbicides is ineffective since deerbrush sprouts readily. Burning without herbicides is also ineffective since deerbrush is hard to burn when it is alive; fire intense enough to destroy green deerbrush would be hard to control, and would probably damage soils.

Bearclover is a unique species which is endemic to the central sierras at mid elevations. Seedlings planted in areas dominated by bearclover show extremely high mortality. Bearclover prefers fertile soils, and although it only grows 1 to 2 feet tall, it can have roots which reach 25 feet into the soil. The roots survive fires beneath the soil, and bearclover easily sprouts back. Cutting off the tops of bearclover is ineffective because of sprouting. Discing is also ineffective since chopping the roots into pieces does not reduce their sprouting abilities. Deeptilling is somewhat effective since the shanks of the tiller "comb" the roots out of the ground. However, this treatment is much less effective on rocky ground or areas with large stumps, and can't be done on ground over 35 percent at best. All suitable ground for deeptilling has already been treated. Applications of Glyphosate (Accord or Round-up) and Triclopyr (Garlon 4) mixed together have effectively reduced bearclover populations on private and public land in the burn. No treatment totally eliminates bearclover, but treatments allow conifers to put down roots and survive.

Non-native annual grasses were aerially seeded after the 1987 fire to reduce watershed impacts. Grass grew throughout the burn during the following wet season, stabilizing the soil, but also producing seed. Although bearclover, and various brush species have taken over many areas, the grass seed remains in the soil. Areas which have been treated for brush or bearclover by deeptilling or foliar herbicides (glyphosate and triclopyr) have often had a resurgence of the grass population, since stored seeds germinate after the removal of the competing species. Annual grasses are very effective at competing with conifers since they grow only during the wet season. After draining the soil of moisture and setting seed, they die off. Since they don't need to survive the dry season, annual grasses are free to use water as fast as possible. Handgrubbing and foliar herbicides are less effective against grass than soil active herbicide (hexazinone) for this reason. If grass is not killed before it produces seeds, then the treatment is ineffective. If the treatment is too early, only the grass seeds that have grown are killed, and other seeds are still in the ground, ready to grow. Hexazinone is active throughout the season, making it harder for seeds to escape. Grasses are usually first to reinvade after treatment.

Heavy vegetation is also a fire hazard, and can lead to the destruction of trees during a fire. Only plantations with low amounts of brush and fuels managed to survive the 1987 fire.

Animals. Gophers, deer and livestock have been known to eat conifer seedlings. Livestock damage is rare; good watering, grazing, and salting practices prevent such problems. Deer prefer to graze on white fir or Douglas fir, and continual feeding can stunt or kill the seedlings. Damage from deer usually occurs only in holding areas on migration routes or in winter range areas. Preventive measures can include natural compounds which repel deer by smell, and devices such as milkcartons and Vexar netting and tubes, which cover the seedling. So far, very little deer damage has occurred in the proposed project area. Gophers are found throughout the area, and feed primarily on the roots and bark of the seedlings. Gophers are prolific rodents, and if there is sufficient grass and forbs in the spring, their populations can increase to epidemic proportions. When spring is over, and food becomes less available, the gophers turn to eating conifer seedlings, and can destroy an entire plantation within 1 to 2 years. Although poisoning and trapping gophers can temporarily reduce a population, the only known way to prevent population increases is to remove the preferred food source of grass and forbs. Currently gopher damage has been found only in small areas within the proposed project area. High rabbit populations can also lead to seedling damage, but this happens much less often.

Diseases. Disease can also potentially inhibit tree survival and growth (LMP, p. III-64). The diseases most likely to affect young plantations in the project area include dwarf mistletoes, root diseases (Annossus root rot and Armillaria) and white pine blister rust (WPBR). There is no current information on the level of these diseases in the project area. It is to be expected that all of these diseases are present in some amounts; infected areas naturally occur even in undisturbed areas. White pine blister rust is an imported disease which fatally attacks sugar pine. Current control is limited to mixing sugar pine with other species to prevent large openings if mortality occurs. Rust resistant sugar pine have been found, and the Forest Service has started a breeding program to produce rust resistant sugar pine seedlings. As this program progresses, more sugar pine seedlings will be available, and sugar pine could be planted in higher numbers. Root diseases and dwarf mistletoes can spread only short distances, from tree to tree. There are currently no post-infection controls except for cutting down infected trees.

Insects. Insects can feed on young trees' roots, needles, buds, bark and cambium. If enough feeding occurs, the damage can stunt or kill the tree. Insect damage can impair short-term (1 to 5 year) plantation establishment by creating understocked areas. Increased potential for insect damage to seedlings exists when seedling are under stress from competition. A seedling's primary defense against insect feeding is to exude sap which repels or even kills insects. Lack of water reduces the seedling's ability to produce sap. Additionally, the large amounts of grass grown during post-fire rehabilitation provides the food and habitat for conifer damaging insects to establish and increase populations. Large acreages of reforested land also provide insects an opportunity to increase in population. Similar conditions occurred after the Granite fire of 1973, leading to a large grasshopper population which killed many seedlings. Insects typically found damaging young trees are grasshoppers, pine reproduction weevil, ponderosa pine tip moth, white grubs and cutworms.

Vegetative Diversity

The proposed project area supports a diversity of natural populations of most tree and shrub species found on the Forest. Many native herb and grass species also occur, although the total numbers are not known. Additionally, the project area provides habitat for 260 wildlife species at various times of the year.

Plant and animal diversity involves the spatial arrangement of vegetation communities and age classes over the landscape, as well as vertical structure within individual vegetative groupings. Diverse vegetation provides varying habitats for wildlife, variation in fuels which enhance resistance to wildfire, interesting scenery, and good conditions for soil and water quality.

A variety of large scale vegetation types existed before 1987. Ponderosa pine, mixed conifer, black oak and canyon live oak woodlands were intermixed throughout the project area. Digger pine/oak, chaparral, and annual grassland types projected into the forest types from lower elevations and river canyon slopes. The break between forest and live oak/shrub/grass habitats is about 3,000 feet elevation, but varies according to soils, slopes and aspects. The majority of stands in the project proposal are above 3,000 feet. There are no stands in the proposed project that are completely below 3,000 feet in elevation. Stands with proposed treatments below 3,000 feet elevation are in Matsen, Paper Cabin, Bear Springs, and Walton Cabin Compartments:

Matsen: 30, 31, 32, 33, 34, 35

Paper Cabin: 37, 38, 41, 45, 50

Bear Springs: 72, 73, 74

Walton Cabin: 86, 235, 236, 237, 238, 239

Perennial grassland and riparian deciduous habitats exist in small amounts. Most permanent meadow habitat (356 acres) within the boundaries of the proposed project area is on private land. Meadow habitats recover rapidly; like shrub habitats they recover fully within 10 to 20 years. Forest habitat recovery takes much longer than shrub or grass habitat recovery.

The largest green island remaining after the burn is in lower Hunter Creek below Road 1N01. The other large patch of remaining mature forest is in Basin Creek, next to unburned forest. Though none of the remaining green areas would be treated in any alternative, their locations make them relevant to the area's long-term diversity. About 5,380 acres of green islands lie within the project area, 3,807 acres of which are National Forest lands.

Before the burn, well developed riparian vegetation existed on nine miles of Hunter Creek, 0.4 miles of Grapevine Creek (National Forest portion), and 1.2 miles of Bear Springs Creek. Some riparian vegetation on Hunter Creek below Road 1N01 survived the fire. The riparian vegetation in Hunter Creek above Road 1N01, Grapevine Creek, and Bear Springs Creek was severely burned and damaged by the fire. These areas are recovering naturally with rapid regrowth of white alder, big-leaf maple, mountain dogwood and willow. Herbs, rushes and sedges have also become reestablished. However, conifers are not regrowing in severely burned areas. Mature conifers are the source of large woody debris, which provides habitat in and near streams, and is needed for soil fertility.

Proposed stands which have some existing riparian habitat are:

Matsen Compartment Stands:

30, 31, 33, 34, 54

Bear Springs Compartment Stands:

28, 64, 65, 71, 77, 105, 122

Walton Cabin Compartment Stands:

9, 30, 31, 75, 76, 87

Proposed stands in which riparian habitat was destroyed:

Bear Springs Compartment Stands:

29, 30, 31, 32, 34, 35, 37, 38, 76, 78, 79, 80

Walton Cabin Compartment Stands:

9, 30, 31, 55, 75, 76, 77, 90

Seral Stage Diversity

The LMP provides for diversity expressed in terms of percentages of the forested land base in different seral stages (LMP, p. IV-38-39). Diversity requirements state that no less than 5 percent of the forested land base be maintained in each of the seven seral stages identified in the LMP (LMP, S&G Seral Stages, (b), p. IV-39; and LMP, p. III-32).

SERAL STAGE	DESCRIPTION
1	Grass-forb stage with or without scattered shrubs and trees.
2	Shrub-seedling sapling stage consisting of mixed or pure stands up to 20 feet tall.
3A	Trees 21 to 50 feet tall, canopy closure 0 to 39 percent.
3B/C	Trees 21 to 50 feet tall, canopy closure 40 to 100 percent.
4A	Trees over 50 feet tall up to 150 years of age, canopy closure 0-39 percent.
4B/C	Trees over 50 feet tall up to 150 years of age, canopy closure 40 to 100 percent.
5	Trees over 150 years old with high degree of decadence.

Table III-2 - Project Area Acres

Analysis Area	Acres	Percent of Project Area		Seral Stage
Project Area	36,059			
Private	7,714	21%	Percent of Private Land:	
Unburned	1,573	4%	20%	3ABC, 4ABC, 5
Burned	5,785	16%	75%	
Unsuitable	1,157	3%	15%	Oak, Brush, Grass
Suitable	4,628	13%	60%	
Planted	3,471	10%	45%	2
Unplanted	1,157	3%	15%	1
Meadow	356	1%	5%	Grass
National Forest	28,345	79%	Percent of National Forest Land:	
Unburned National Forest	3,807	11%	13%	3ABC, 4ABC, 5
Burned National Forest	24,538	68%	87%	
Unsuitable	11,893	33%	42%	Oak, Brush, Grass
Suitable	12,645	35%	45%	
Planted	4,675	13%	16%	2
Unplanted	7,970	22%	29%	1

Private land was not field surveyed, but approximately 80 percent of the burned private lands are capable of growing conifer stands, of which approximately 75 percent have been reforested.

Of the National Forest land which is suitable for reforestation, 37 percent has been planted; this is 16 percent of the National Forest lands. Almost two-thirds of the National Forest land which formerly grew conifer and conifer/oak forests remains unplanted.

With less than one seventh of the National Forest land having survived with a cover of mature trees, it is obvious that seral stages 3A, 3B/C, 4A, 4B/C, and 5 have been drastically reduced. This area does not meet the minimum LMP goal of 5 percent of each seral stage. Seral stage 1 is comparable to unplanted areas, which are 25 percent of the National Forest land. Seral stage 2 consists of areas with seedlings, which make up 16 percent of the National Forest lands. Under current conditions, many seral stage 2 areas may revert to seral stage 1 if mortality continues. Almost half (45 percent) of the National Forest land is comprised of two similar early seral stages, and only 13 percent is comprised of mature conifer seral stages; seral stage diversity is very low compared to pre-fire conditions.

Areas unsuitable for reforestation primarily consist of oaks, brush and grass. This type of vegetation recovers quickly, as the principle species begin immediately to sprout or germinate in burned areas. These are fire resistant species, so species composition was little changed by the fire.

Structural Diversity

Structural diversity is the level of variation in stand structures such as trees, snags, logs and brush. These combine to provide variation in stand heights, species, wildlife perches, forage and cover, shade and more. Vertical diversity is based on the variation of vegetation heights and layers in one area; an area with conifers of various heights, oaks and brush underneath would have high vertical diversity. Horizontal diversity is based on the variation of vegetation across a stand; a stand with patches of brush, trees and grassy openings would be considered to have high horizontal diversity.

Presently the only areas with high vertical diversity in the project area lie within the 3,000 acres of green islands. All other areas have low vertical diversity and support sprouting shrubs such as manzanita, deerbrush, toyon and yerba santa; sprouting hardwoods such as black oak and canyon live oak; and grasses and forbs. Compared to prefire conditions, the vertical diversity is poor because of the lack of tall conifers. If left to natural recovery, a hardwood-shrub habitat would dominate for many decades before conifers would return to their previous numbers.

Other components of within-stand diversity are non-living components such as snags and down logs, and other dead woody debris. During fire salvage logging and biomass removal, snags were left mainly in groups, at about 1.5 per acre; about 5 large logs per acre were left wherever possible. The snags will not stand beyond 25 years and will eventually serve as down logs. These important elements provide for wildlife habitat and soil nutrient recycling. Without planted conifers, many areas in the project area have no future source of snags and down logs. Except in the green islands, snags and logs currently available will not survive to provide diversity in the next generation of forest trees. It takes 40 to 45 years on average sites to produce trees 16 inches in diameter, which could be killed to provide snags. It takes 55 to 60 years to produce trees with 20 inch diameters. Snags 20 inches in diameter or larger are preferred by wildlife and larger cavity-nesting birds.

Species Diversity

Species diversity (LMP, p.III-31) is based on the number of different species, both plant and animal, that an area can support; number of individuals in each species does not affect this. Management practices influence species diversity to a high degree. Potentially detrimental practices are herbicide use near threatened, endangered or sensitive plant species; reforestation with limited species or gene pools; or practices that encourage invasion by non-native species.

Nearby reforestation efforts on private land include herbicide use. Herbicide site preparation and release treatments suppress major moisture-competing plants for 3 to 5 years but do not eliminate them from the site. As noted above, treated areas on private land showed 30 to 60 percent cover in competing vegetation after five years. Timing and application techniques make it possible to selectively treat competing vegetation. Even in the past, when there was less understanding about maintaining species richness, attempts to kill all competing vegetation usually failed. Species are not eliminated, but composition can be altered. Since use of herbicides was for the purpose of re-establishing conifer species, and other species are still present, diversity has actually been increased in these cases. The Forest Plan (LMP, Hardwoods Management, p. IV-176) requires leaving at least 10 square feet per acre basal area of black and canyon live oak, where it occurs. This standard would prevail in the project area except where higher amounts of oak retention are desired. Species diversity has been lowered by the fire because conifers no longer exist in many areas, thus reducing the number of species present.

Herbicides easily reduce herbaceous species, and the potential for impact exists if a species is rare or very localized. The only rare plant known in the project area is the Tuolumne fawn lily, which is discussed below. Most herbaceous plants existing in the burned areas reinvade easily.

Only native tree species (to the Sierras), including ponderosa pine, Douglas-fir, white fir, incense-cedar, sugar pine and giant sequoia, are planted on National Forest Lands. Forest Service nurseries grow and provide native conifer seedlings. The common practice is to plant about the same species mix as the original forest composition. Species planted from 1988 through 1990 reflected the pre-fire overstory composition. The only exceptions were sugar pine and giant sequoia. Less sugar pine was planted because it suffers high mortality from white pine blister rust. Sugar pine rarely comprises more than 20 percent of the total planted seedlings, unless they are resistant to white pine blister rust. In this case, the percentage would increase. Although giant sequoia is native to the Sierras, the seed comes from sequoia groves outside the project area.

Native conifer species have high amounts of genetic diversity, even within small groups. Maintaining this diversity is important, since natural variation allows populations to survive new or reoccuring attacks by insect or disease, or natural variations in climate. Forest Service policy is to improve economically important timber traits while maintaining high genetic diversity and population adaptability. Desired traits include fast growth rate, good wood quality, and pest resistance. Seed is collected from local seed zones and trees which exhibit the desired traits. Maintaining genetic diversity results from:

Collecting seed from a broad base of trees and stands of local origin

Using practices that favor high nursery and forest survival

Planting as densely as economics allow

Planting appropriate species and genotype mixtures

Encouraging natural regeneration in plantations

Timing and spacing of planting stock

Sensitive Species:

The only rare plant species in the project area is Tuolumne Fawn Lily (*Erythronium tuolumnense*), a Forest Service Sensitive species. There are thirteen known populations within the project area, three of which are on national forest land subject to potential effects from this project. There are a total of 25 known populations, all in drainages tributary to either the Tuolumne River or the South Fork Stanislaus River, and all on the Mi-Wok Ranger District. This species lives on cool, shaded, north facing slopes, from 1,200 to 5,000 feet in elevation, growing in chaparral, oak woodland or ponderosa pine habitats. The plants are very ephemeral, appearing in early spring and withering soon after flowering, perhaps by early June. After plants have withered, foliar herbicides and broadcast burn treatments would have no effects on the plants. Site-specific surveys are conducted before implementing any management practices that could affect potential populations (see Chapter 2, Mitigation and Monitoring). The three known populations are in the Murphy Peak, Bear Springs and Paper Cabin compartments. All populations are protected during any activities (Chapter 2, Mitigation and Monitoring). An Interim approved, 8-4-90, Management Guide for Tuolumne Fawn Lily exists.

J. Water Quality

The watersheds within the project area are all part of the Tuolumne River drainage. At 1,380 square miles, the Tuolumne is a major tributary of California's San Joaquin River, the principal river draining most of the central and southern Sierra Nevada mountains. Two major tributaries of the Tuolumne River lie partly within the project area, the Tuolumne's North Fork and the Clavey River. Their principal subwatersheds within the project area are Hunter Creek (9,500 acres), Grapevine Creek (4,500 acres), Duckwall Creek (4,400 acres), Bear Springs Creek (3,500 acres) and Quilty Creek (1,100 acres). Refer to Map 3-1 for location of drainages and watersheds.

Streams in the project area's subwatersheds are small perennials. Their peak annual streamflow normally occurs in the winter and spring months (January-March). Flow then rapidly tapers off to a low-flow period from June through November after which the rainy season begins. Many headwater areas of these drainages have intermittent and even ephemeral flows. Usually only the main channels of these creeks flow year round. Average annual peak winter flows are estimated to range from about 200 cubic feet per second (cfs) in Hunter Creek to 25 cfs in Quilty Creek. Summer low flows are less than 1 cfs for most streams.

The project area, before the fire, contained an inland fishery of rainbow and brown trout in Hunter Creek and in the main channels of the North Fork Tuolumne and Clavey Rivers. Hunter, Grapevine, Duckwall, Basin and Bear Springs Creeks provided valuable riparian habitat where stands of old growth Douglas-fir, ponderosa pine, white fir, incense-cedar, alder, willow and maple lined the channels. For stream segments disturbed by the fire and in need of recovery see Chapter 2, Monitoring and Mitigation, Riparian.

Beneficial uses of water occur within and downstream of the proposed project area. There are several licensed water rights at springs within the project area. There are instream beneficial uses for recreation and fishery in Hunter and Basin Creeks and in the North Fork and main channel of the Tuolumne River. On private inholdings within the project area water is used for domestic, fire protection and stock watering purposes. The principal beneficial use of water downstream from the project area is Lake Don Pedro, a two million acre foot reservoir operated by the Turlock Irrigation District. This large reservoir serves for irrigation and domestic water downstream in the Central Valley.

Paper EIS Watershed Map

Watershed Key Map

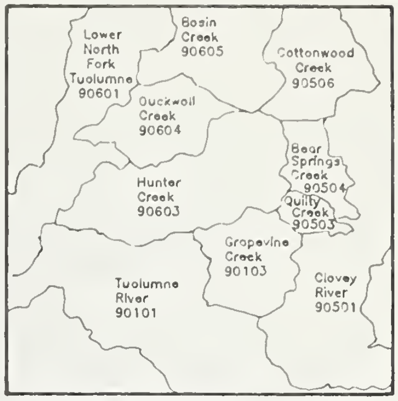


TABLE III-3: BENEFICIAL USES OF WATER - PROJECT AND ANALYSIS AREA

WATERSHED NAME	BENEFICIAL USES							
	DOM	POW	REC1	REC2	COLD	WILD	STOCK	FIRE
Basin Creek	X			X	X	X		X
Clavey River			X	X	X	X	X	X
Duckwall Creek				X	X	X	X	X
Grapevine Creek	X			X	X	X	X	X
Hunter Creek				X	X	X	X	X
North Fk Tuolumne R.	X		X	X	X	X		X
Tuolumne River	X	X	X	X	X	X	X	X

DOM - domestic use; POW - power generation; REC1 - water contact recreation; REC2 - non-contact water recreational uses; COLD - cold water fish habitat; WILD - wildlife use; STOCK - stock watering use; FIRE - fire protection.

Current Watershed Condition. The following assessment of the current watershed condition results from four watershed surveys, monitoring the effects of post-fire salvage logging, and numerous field observations since 1987.

The first survey, immediately after the 1987 fire, determined that a threat existed to property, soil and water resources in and downstream of the proposed project area. This threat lead to immediate efforts to stabilize the watershed by aerially seeding annual rye grass on areas most susceptible to erosion. Although, post-fire erosion and sedimentation did occur from storms in the early fall of 1987, before the grass germinated and grew, project area watersheds became well covered with seeded grass by early-winter. Grass seeding contributed greatly to the good watershed stability currently existing in the project area. The series of drought years following the fire also helped minimize erosion.

The second survey, in 1988, evaluated post-fire riparian conditions. This survey concluded that (1) conifers, in many of the riparian areas, were burned beyond recovery, and (2) hardwoods were partially burned.

These riparian areas were resurveyed in 1991. This survey found that (1) conifers were not recovering, and (2)resprouting hardwoods were recovering well in some areas and not well in others.

At presént, riparian recovery is desired and planned. See Chapter 2, Mitigation and Monitoring, Table II-11.

Watershed effects of fire salvage were monitored in 1988 and 1989. While some site-specific erosion and sedimentation was noted, the continuing growth of seeded grass, regrowth of native vegetation

and additional ground cover from logging residue offset the occasional adverse harvest effects. Negligible effects occurred from salvage logging on national forest land within the project area.

In addition to fire salvage monitoring in 1989, a ground cover and stream channel condition survey determined that:

> National forest lands had, with few exceptions, greater than 50 percent ground cover density. This included seeded grasses, native shrubs, native grasses and forbs, and resprouting hardwoods.
>
> Native plants were crowding out the seeded grasses.
>
> Vegetation was regrowing on streambanks.
>
> Numerous streambeds remained loaded with sediment resulting from early fall 1987. Hunter Creek was the most affected, and fish habitat remains poor.

In summary, good watershed conditions exist, resulting from improvements since the 1987 fire. Those improvements include the appearance of seeded and native vegetation which have stabilized the project area watersheds.

Ground Water. A site-specific assessment of the potential risk of herbicide entering the groundwater is included in the Paper EIS. Where the potential existed, treatment was altered to eliminate the risk. Glyphosate and triclopyr are foliage active herbicides and do not enter ground water. Hexazinone is a soil active herbicide, and all stands prescribed with hexazinone are included in the risk assessment.

The prescriptions apply Hexazinone at 1 to 3 pounds per acre active ingredient, depending on soil organic content. Application occurs in the spring when at least 2 to 3 inches of rain is expected. Hexazinone does not leach below the grass rooting zone if spring rainfall does not exceed 3 inches.

Wells represent artificial withdrawal while springs represent natural discharges of ground water. The State Water Resources Board maintains water well records. A record search identified wells within 1 mile of stands prescribed for hexazinone. In addition to well locations, well records indicate the depth to water. Consultation with the Forest Hydrologist identified the major springs. Only stands that are upslope from springs, or higher in elevation than the depth of well water, are potentially at risk.

Based on this screening process, a total of 51 stands in the project area required on-the-ground review. This review determined the risk of hexazinone entering the ground water based on the area's site-specific conditions. These site-specific conditions include distance between wells and springs, aquifer characteristics, and the soil organic content and clay cation exchange capacity. Treatment stands at risk occur in all compartments except Cottonwood.

Out of the 51 potential stands at risk, the site-specific analysis indicated that hexazinone could enter the ground water in the 18 stands shown in Table 3-3, if mitigations in Chapter 2 are not followed:

TABLE III-4: STANDS SUSCEPTIBLE TO GROUND WATER CONTAMINATION

Compartment	Stand	Acres	Well/Spring
Murphy	30	39	Wells # 270916 and # 270911
	31	39	Wells # 270916 and # 270911
Paper	17	20	Spring along Forest Road 1N19
	20	18	Wells # 096590 and # 096591
	22	31	Wet Meadow Spring
	23	43	Wells # 096590 and # 096591
	29	30	Wet Meadow Spring
	30	45	Wet Meadow Spring
Walton	4	7	Round Meadow Spring and Well #100372
	6	19	Round Meadow Spring and Well # 100372
	7	27	Round Meadow Spring and Well # 100372
	61	10	Indian Spring
	63	11	Indian Spring
	70	25	Indian Spring
Bear Springs	16	5	Well # 062859
	18	21	Well # 062859
	19	31	Well # 062859
	49	43	Springs near Forest Road 1N04
Total Acres		464	

These stands are located over metamorphic bedrock with an inter-connected fracture network capable of leading ground water off-site to wells within one-half mile. Shallow regolith aquifers are located upslope, and are sufficiently continuous to carry ground water to affected springs. The soils contain low organic content and/or clays.

K. Wildlife/Fisheries

Before 1987, the dominant wildlife habitat in the general project area consisted of ponderosa pine/ mixed conifer and black oak woodland with smaller amounts of mixed conifer, riparian deciduous, chaparral and meadows (private land). The most important habitat, regarding wildlife use and fire effects, were ponderosa pine/mixed conifer, black oak and riparian. The numbers of species associated with these habitats are 185, 157 and 165, respectively.

The total number of wildlife species using the project area at various times of the year are: 156 species of birds, 70 mammal species, and 37 species of amphibians and reptiles for a total of about 263 species (Verner and Boss).

Grasses, shrubs and acorns provide forage for wildlife. Most burned shrubs and hardwood trees sprout from the base. Grasses and herbs abound on all ground not occupied by sprouting crowns. Black and canyon live oak, which were not killed above ground, are presently sprouting from aerial limbs. These oaks recover to become acorn producing within a few years, whereas the root-sprouting oaks take 15 to 20 years. Conifer habitat types, however, will not naturally recover for centuries.

Species designated by the Regional Forester as Sensitive include California spotted owl, northern goshawk, great grey owl, willow flycatcher, Pacific fisher, marten and Sierra Nevada red fox. A complete Biological Evaluation (BE) addressing sensitive species is on file at the Mi-Wok Ranger District office. The BE reviews existing conditions and activities associated with reforestation to determine whether proposed actions could result in a trend toward a Sensitive species becoming Federally listed.

Species Federally listed as threatened, endangered, candidate, or proposed for listing and which could potentially occur in the project area include bald eagle, peregrine falcon and Lahontan cut-throat trout. A complete species list was requested from the U.S. Fish and Wildlife service on January 24, 1992. However, since reforestation activities would occur only in burned areas, no suitable habitat for these species exists in the project area.

Major groups of fish and wildlife are classified based upon forest seral stages and special habitat associations. The groups and their habitat are categorized as follows: Early seral stage wildlife, late seral stage wildlife, oak-associated wildlife, snag and down log dependent wildlife, Riparian wildlife and Fisheries.

Management indicator species ([MIS] LMP, p. III-40; Table III-2, p. III-41; p. III-47; and Table III-15, p. III-49) are particular plants or animals whose habitat needs represent the needs of other species and which can be used for management and monitoring. Their presence or absence is a fairly certain sign or symptom that particular environmental conditions are also present or absent. Indicator species for the seral stages and special habitat associations listed above are identified below.

Early Seral Stage. Early seral stage indicator species are mule deer and mountain quail. Other examples are yellow pine chipmunk, badger, gray fox, bobcat, mountain lion, poor-will, red-tailed hawk, western bluebird, fox sparrow and robin. These species require early seral stages of grass, herbs, brush and seedling/sapling tree stages for a part of their life.

> **Mule deer (This section includes new information on deer winter range based on telemetry research. For more information, refer to Appendix 7).** About 2,500 deer (a portion of the Tuolumne Deer Herd) move into the project area during the winter from higher elevation summer ranges. Before the fire, the project area provided wintertime hiding and thermal cover, and forage from browse and acorns. Hiding cover protects wildlife from predators and harassment; thermal cover maintains body heat during cold winter weather. The pine and oak dominated stands provided excellent hiding and thermal cover. Acorns from black and canyon live oaks provided substantial forage. These habitat structures have either been destroyed or reduced by the 1987 fire.
>
> There are about 20,000 acres of winter range in the project area (including portions of private land). This supports a winter population of about 1,000 deer, or about one deer per 20 acres. Presently, carrying capacity is lower than before the burn because the habitat capability decreased due to lack of escape and thermal cover. In the next 20 to 75 years the project area has the potential to support up to 2,500 deer during the winter season.
>
> The optimum distribution of cover-to-forage ratio for critical deer winter range is 60:40, or 60 acres of cover habitat for every 40 acres of forage habitat (LMP, p. IV-174). Medium distribution ranges from 90:10 to 35:65.

Abundant browse species currently provide high quality forage in place of the now largely absent acorn mast. Presently, the main deficiency is winter deer cover, including along some of the main riparian migration routes from higher elevations.

Locations of deer winter range are identified in the Forest Plan (LMP, Appendix I, Map 2).Areas currently meeting thermal cover, forage, and hiding cover are within the green island along lower Hunter Creek below Road 1N01; and in the 3,807 acres of green islands.

New Telemetry Research on Deer Winter Range

This document also incorporates new information regarding deer winter range that was obtained through telemetry research after the Forest Plan was adopted. The California Department of Fish and Game (CDFG) began its telemetry research (J. Maddox, 1986-1992, refer to Appendix 7) on the premise that the Plan's critical winter range, identified in the early 1980's on the south facing slopes of the Clavey River canyon, did not represent all areas that were critical to these deer.

The Forest Plan includes specific direction for special management for mule deer (representing early seral stage wildlife), primarily in portions of the winter range below 4,500 feet elevation. Two levels of geographic preference were shown on the Forest Plan Wildlife Map: Concentration areas and Critical Areas (within concentration areas). The Forest Plan contained specific management direction for Critical areas, but not for Concentration areas.

Properly identified critical winter range should reflect areas that are used almost every year to sustain the bulk of the herd through the difficult winter months. The highest deer use, based on density throughout the winter, occurs in critical habitat. Less dense use occurs in concentration areas. Even less use occurs in areas outside of concentration areas on the general winter range. Most of the Paper reforestation project area includes both critical and concentration winter ranges for the Clavey subunit of the Tuolumne River Deer Herd.

Identification of the critical areas is generally based on field observations, and the critical areas for some herds have been better identified than others due to deer use patterns and good winter access for biologists. It was evident to the CDFG that critical winter range identified in the Forest Plan on the south facing slopes of the Clavey River canyon in the early 1980s did not represent all areas that were critical to these deer. Thus, CDFG began a telemetry study in 1986 to determine migration patterns, holding areas and critical winter range.

During the period between 1986 and 1992, deer were trapped, equipped with radio collars and followed by tracking equipment during all months of the year (Maddox, 1993). This study coincided with a drought. During years of future heavy snowfall, the use pattern identified in this study will change to reflect more dependence on the lower winter range.

The Forest Plan based its identification of critical deer winter range on the Tuolumne River Deer Herd Management Plan (CDF&G/USDA 1980), which locates upper and lower winter range (cited in LMP, I-2 and III-59). Most of the winter range, according to that plan, is located in the project area. The lower winter range is largely on south facing slopes of the Clavey River Canyon. However, the more recent telemetry data on individual deer that migrated every summer to higher country and returned again in the fall showed a clear preference to small meadows, browse patches, drainages in the upper winter range between Hunter Creek and the top of the Clavey River Canyon, and the area just south of the Murphy Ranch in the Matsen Compartment. Areas adjoining meadows on private lands were especially important. All these

areas except for the Matsen Compartment are within the area identified in the Forest Plan Wildlife Map as Concentration area.

Migration routes are not included within critical range management provisions in the Forest Plan, partly due to the difficulty of accurately identifying them. Because of the radio collars on individual deer, the CDFG was able to identify several routes of movement of migrating deer each year out of the winter range, through upper Hunter Creek and around the east and west sides of Duckwall Mountain.

The CDFG telemetry study validated earlier suspicions about the use and importance of the upper winter range to this subunit of the Tuolumne Herd. This new information will be useful to CDFG and the Forest Service in planning for management of the deer herd and its habitat.

Mountain quail. Mountain quail inhabited the project area prior to the fire, preferring shrub and oak/shrub habitats close to conifer trees and close to water. Quail migrate to higher elevations in the summer and down into chaparral in winter. The size of the quail population is unknown. Key elements of suitable habitat are shrubs (or other vegetation), two to over six feet tall. Mountain quail have an average breeding territory of 25 acres, and produce an average covey size of 11 young.

During nesting, quail remain within 1/4 mile of water. Their exact location varies depending on climate. Drought conditions reduce, and wet years increase population levels and the stands that support mountain quail.

Late Seral Stage. Spotted owl and goshawk are late seral stage indicator species. Presently, there are about 5,380 acres of green island that contain late seral stage habitat. About 45 species of mammals and birds are included in the late seral stage, including Pacific fisher, flammulated owl, purple finch, brown creeper, Hammond's flycatcher and pileated woodpecker. Late seral stage species either require or are highly dependent on mature forests with large trees with open to dense crown canopy conditions. Decadence (snags and down logs) is also an important feature for most species.

Spotted Owl. There is one spotted owl habitat area (SOHA) being considered for long-term management. SOHA M16 (LMP, Appendix G, p. G-1; Map I-1) is in the Basin Creek drainage at the north end of the proposed project area. About 216 acres of destroyed habitat exists from the 1987 burn. This will remain unsuitable for at least 50 years, assuming successful reforestation. M16 has 955 acres of suitable habitat, some outside the burn.

Monitoring since 1987 indicates the SOHA is being used by one pair of owls, although reproductive success is unknown. The project area probably supported at least one other pair of owls before the fire, most likely in the dense forest habitat on north-facing slopes along Hunter Creek. Presently the green island of unburned habitat in lower Hunter Creek is insufficient to support a nesting pair of spotted owls. However, it most likely supports individual non-breeding spotted owls.

The area has geographic and biological potential to support up to five pair of breeding spotted owls, based on the existing M16 and the potential for four other SOHAs developing over the next 100 to 200 years. These habitats could cover more than 90 percent of the stands in the project area.

Goshawk. Goshawk have been observed in the area, although no goshawk nesting territories have been identified in the project area either before or since the 1987 fire. Based on habitat and territory requirements, the project area potentially supported up to four pair before the fire. Potential locations are one site in portions of SOHA M16, two sites on Hunter Creek (upper and lower Hunter Creek), and one site in the Walton Cabin area. Presently, there could be one pair in lower Hunter Creek and one pair in Basin Creek, but one pair total is more likely.

Each nesting pair may require a non-overlapping home range of about 5,000 acres, and distances between nests usually are no closer than 3.5 miles. Nest stands require large trees with dense canopy cover (over 70 percent) and can be as small as 40 acres. Repeatedly used nest stands are at least 120 acres in size.

Oak Dependent Wildlife. Western gray squirrel is the oak-associated indicator species. Other examples are acorn woodpecker, Stellar's jay, white-breasted nuthatch, varied thrush, black-headed grosbeak, band-tailed pigeon, black bear and mule deer. These species depend heavily on acorns for food or use oak trees for feeding, cover, or nesting. There are about 60 species in this group (Verner and Boss).

There were about 5,600 adult western gray squirrels in and adjacent to the project area before the 1987 fire. This large population was due to the occurrence of black oak and canyon live oak distributed throughout the project area at different densities. The following estimated gray squirrel population densities are based on the home ranges and defended territories of male and female squirrels:

One per two acres in moderate to good habitat where oak stocking is 30 to 50 square feet of basal area per acre

One animal per four acres in habitat where the oak stocking is 15 to 30 square feet per acre

One animal per 6 acres where oak stocking is only 10 to 15 square feet per acre

Presently, capable habitat is within the green islands. This habitat ranges from being unsuitable for western gray squirrel to having high capability. An estimated 920 animals populated the unburned green islands in the project area.

Forest Plan management would provide for different levels of oak. The intensive oak prescription is 36 square feet basal area per acre. This prescription is for critical winter deer range and where oak-dependent animals are emphasized. The minimum level provided by LMP Standards and Guidelines is 10 square feet per acre and applies everywhere oak tree species occur (LMP, p. IV-176). The areas managed as 36 square feet per acre (if 50 percent of the oaks are over 60 years of age and are good acorn producers) would provide habitat to support an average of one adult squirrel per two acres.

It is estimated that for each square foot of black or canyon live oak desired in 20 years, one clump of sprouting oak suckers should be retained during reforestation (based on 17 year observations after the Granite Fire). The number of oak sprouts throughout the project area is unknown, although most areas have more than enough oak sprouts to meet desired levels.

Snag and Down Log Dependent Wildlife. White-headed woodpecker and pileated woodpecker are snag-dependent indicator species. Pileated woodpecker also indicates late seral stage forest habitat. Other species are Lewis' woodpecker, common flicker, hairy woodpecker, flammulated owl, mountain chickadee, red-breasted nuthatch, western bluebird, tree swallow, silver-haired bat and northern flying squirrel.

About 29 bird species and 15 mammal species use snags in the project area. Burned areas support fewer species because of the lack of canopy for feeding and cover. Snags remain in the green islands and in groupings throughout the fire salvage and biomass areas at about 1.5 per acre.

Snags fall down over time and few remain beyond 25 years. The greatest use is among groups of fifteen or more snags, near green living trees and near water. Most wildlife species prefer snags between 16 and 33 inches in diameter. Smaller snags have little benefit beyond about 5 years.

Logs and other woody debris are important elements of diversity in the forest environment, used by an estimated 100 vertebrate species. Although there are no specific indicator species for down logs, most mammals and amphibians and many birds do use them. They are also an important feature of healthy streams. The Forest Plan has a Standard and Guideline that manages for three logs per acre measuring a minimum of 20 feet long by at least 15-30 inches diameter (LMP, p.IV-76)

White-headed woodpecker. This common resident in pine and mixed conifer forests excavates cavities for nests in dead trees over 10 inches in diameter with a minimum height of 6 feet. The white-headed woodpecker has an effective territory requirement of 20 acres per pair and requires 2.25 snags per acre to reach this population density (5 pairs per 100 acres). At 1.5 snags per acre, the Forest standard in most areas, the population would be at 70 percent of full potential, or an average 29 acres per pair (3.5 pairs per 100 acres).

Many areas did not meet the 1.5 snags per acre before the burn. Before 1987 the population was about 50 percent of potential because of the snag size and nesting height flexibility of the white-headed woodpecker. This is 2.5 pairs per 100 acres or about 258 pairs of white-headed woodpeckers. Suitable habitat currently exists where there are snags, and in green islands where post-fire mortality occurs. The limiting population factor, now, is the lack of conifers with greater than 40 percent canopy cover, another habitat preference for the white-headed woodpecker. The existing population, mostly limited to the green islands, is estimated at 105 pairs.

Pileated woodpecker. This large woodpecker usually associates with old growth forests with a lot of decayed organic matter, including large snags for nesting and feeding. They require snags at least 20 inches DBH and 30 feet tall for nesting. The territory size for a nesting pair is about 400 acres. One hundred percent population potential requires 14 snags per 100 acres greater than 20 inches DBH, or an average of 0.14 snags per acre. This woodpecker also prefers large conifers with a forest canopy closure of over 40 percent.

The pileated woodpecker was scarce before the 1987 fire because of sparsely stocked remnant old growth, areas of second-growth, and the general lack of large snags. Pileated woodpeckers probably lived in the dense conifer stands in upper and lower Hunter Creek, and in the mature stands in SOHA M16. The project area has a biological potential of up to 36 pairs, but would require 75 to 100 years to develop this habitat. Currently, capability is one pair in Basin Creek, and one pair in the unburned habitat on lower Hunter Creek.

Riparian Dependent Wildlife. Yellow warbler is the indicator species for riparian associated wildlife. Other examples of riparian dependent wildlife are Cooper's hawk, downy woodpecker, dipper, house wren, common yellow throat, northern oriole, song sparrow, MacGillivray's warbler and raccoon. This group is highly adapted to using riparian habitats for feeding or reproduction.

Riparian habitat includes alder, big-leaf maple, mountain dogwood, willow, azalea, chokecherry, and other shrubs and herbs. Usually, there are conifers and oaks growing in the outer portion of the riparian zone. This conifer and oak overstory and riparian shrub or tree understory adds important aerial diversity to the riparian habitat.

The main potential for providing riparian habitat is on about 11 miles of the perennial portions of Hunter Creek, Grapevine Creek, and Bear Springs Creek (includes lower Hunter Creek). Severely damaged or destroyed riparian habitat exists on 4.2 miles of upper Hunter Creek, 0.4 miles of Grapevine Creek (NF portion), and 1.2 miles of Bear Springs Creek (5.8 miles). Minimal fire effects occurred on about 5.2 miles of lower Hunter Creek. Intermittent streams provide limited additional potential for another 27 miles.

> **Yellow warbler.** This species lives in riparian deciduous habitats along streams, next to lakes, or in shrubby meadow environments at medium elevations. For nesting, it requires dense shrubs or young trees near water, and nests at all heights up to 10 feet. The size of its breeding territory size is about 0.5 acres per pair in optimum habitat. Estimated population density on perennial streams before the fire was much lower at about 11 pairs.
>
> Before the fire, the yellow warbler lived along Hunter Creek and possibly on the other smaller drainages. Because of a poorly developed shrub understory before the fire, low habitat capability existed. This probably supported a population of one pair per mile.
>
> There are about 12 acres of riparian habitat per mile of perennial stream, and 6 acres per mile on intermittent streams. In addition there are about 132 acres of riparian habitat on the 11 acres previously discussed. These 27 miles of intermittent streams could support about 27 acres of riparian vegetation, but would probably still be unsuitable for yellow warbler.
>
> Currently, low capability habitat exists on lower Hunter Creek for an estimated 5 breeding pairs. The recovery of riparian habitat will probably take 20 to 50 years, depending on the severity of burn damage and reforestation work.

Fisheries. Fire effects occurred on the naturally sustained fisheries in Hunter, Grapevine, and Bear Springs Creeks. Of these, Hunter Creek was the most productive and contained a good population of brown and rainbow trout. After the fire, much of the population in the lower nine miles of Hunter Creek was decimated. This was a result of sedimentation created by intense rains on denuded slopes within the watershed. Fish suffocated from clogged gills and/or were displaced when their habitat filled with sediments.

Fish repopulation is occurring by movement downstream from the upper reaches of the creek that were not affected by the fire. The fisheries in Grapevine and Bear Springs Creeks were not significantly affected by the fire and still contain small trout populations.

Amphibians. The red-legged frog, foothill yellow-legged frog and western pond turtle are native amphibians that have suffered extreme population declines throughout their range. The frogs exist

in or near streams and riparian vegetation in the foothills and forests up to about 4,500 feet elevation. Historically, their populations were much higher than at present.

Western pond turtles require the same type of aquatic habitat as frogs, but are known to range up 100 meters from streams to find nest sites.

All of these species would have found suitable habitat along the 11 miles of perennial streams and perhaps on other streams prior to the fire.

The fire undoubtedly had a serious effect on amphibian numbers, but there is recent evidence of residual frog occurrence (either red-legged or yellow-legged) on Hunter Creek and possibly in nearby ponds.

Other Species. Great gray owl, willow flycatcher, fisher and red fox are other species of concern, but are not management indicator species. They have the potential to occur in the project area, or to have occurred before the burn.

It may not be feasible to accommodate all vertebrate species that potentially use the proposed project area. Fisher, red fox, and other species require large territories and late seral stage habitats. Other parts of the Forest better meet these species' requirements, where fire and logging history have had less influence. In the project area, with its management and fire history, reasonable objectives strive to: protect all native plant species from elimination, and provide for all wildlife and fish species to the degree that existing habitat, future potential habitat, and other resource objectives make possible.

Great Gray Owl. This species usually nests above 4,500 feet but has also been found nesting at elevations and in habitat characteristic of the project area. It requires dense stands of trees, with large broken snags for nest sites, next to meadows or other open habitats for foraging. There are no records of this species in the project area, but suitable habitat exists on adjacent private land associated with meadows. Capability existed before the burn for up to three pair of great gray owls. The existing unburned habitat around meadows on private land may provide habitat for one to two pair of great gray owls. No capability exists for great gray owls on National Forest land at this time, and the only long-term potential is on private land.

Willow Flycatcher. This uncommon species associates with stands of willows in meadows or riparian habitats. It occurs at similar elevations elsewhere on the Forest (Ackerson Meadow) but it has not been seen within the project area. Possible reasons for its population decline in California are nest parasitism by brown-headed cowbirds, and cattle grazing of willow stands. No meadow habitat occurs within the project area, but there is some potential within the riparian areas. Managing the riparian zones for full recovery provides all the potential habitat for this species that is possible.

Fisher. This species requires a large home range and dense forest conditions including snags and down logs. A reproductive unit (room for one male and two females) is at least 6,000 acres in size. Pre-burn conditions provided suitable habitat along Hunter Creek, and along some stretches of the Clavey River between Bear Creek and Thirteenmile Creek.

Project area habitat is presently unsuitable for any use by fisher. The Forest has a fisher interim strategy for population viability which uses designated areas for late seral stage management. These are scattered across the Forest at intermediate to high elevations. Two of these areas

are centered on SOHAs M09, M10, M17, G03 and G04 along the Clavey River, about 1-2 miles northeast of the project area.

Spotted owl and goshawk management also provides for fisher habitat capability. The only consideration that may limit future use is habitat corridors with other habitat outside the project area.

Red Fox. There are no verified records of red fox in the project area. This species normally is found at higher elevations but could live here. Red fox habitat benefits by the diversity resulting from management for spotted owl, goshawk, and pileated woodpecker. The area is not targeted for red fox emphasis in the LMP.

IV. ENVIRONMENTAL CONSEQUENCES

This chapter presents a scientific analysis that addresses the issues discussed in Chapter 1 by comparing the direct, indirect and cumulative consequences of each alternative on the physical, biological, social and economic aspects of the environment.

As required by CEQ and NEPA, the analysis also addresses adverse environmental effects that cannot be avoided; the relationships between short-term uses of the human environment and long-term productivity; irreversible and irretrievable commitment of resources; possible conflicts between the proposed action and plans of Federal, State and local agencies; and energy potential and conservation potential of various alternatives and mitigation measures.

A. Air Quality

The primary air quality concerns identified for this project revolve around the effects of the alternatives in relation to Issue #1 in Chapter 1 regarding (1) PM_{10} smoke and dust emissions from pre-planting prescribed burning and its consequent visibility impairment in smoke sensitive areas, and (2) visibility protection for nearby Class 1 airsheds (the Emigrant Wilderness and Yosemite National Park). Smoke and dust are pollutants in the "particulates less than 10 microns in size" (PM_{10}) category. These particulates are regulated by the State of California and the Federal Clean Air Act to protect human health, as well as visibility. (The herbicides proposed for use in this project are not on the list of 189 air toxics identified in the 1990 Federal Clean Air Act amendments, and are therefore unregulated with respect to air quality standards.) The California PM_{10} standard is 50 micrograms/meter^3, averaged over a 24 hour period. This standard is three times more stringent than the federal standard, which is 150 micrograms/meter^3.

Since the 1987 firestorm, all mechanical treatments have been completed. The more important consideration at this point, regarding air quality, is the extent to which prescribed burns for fuel reduction and site preparation create smoke. The potential for smoke is relative to the number of acres within each alternative undergoing prescribed burns.

A significant concern regarding broadcast burning is the potential for off-site movement by wind erosion resulting from loss of ground cover. Smoke can be carried by wind currents to other parts of the forest or to wilderness areas.

Alternative 1

Direct Effects

Over the span of 4 years, 1,127 acres of broadcast burning for site preparation and 2,205 acres of broadcast burning for fire risk reductions to newly planted areas would occur. These activities would create smoke emissions. If mitigation measures, such as timing are followed, these activities would not be expected to exceed the state PM_{10} standard for the air basin in which the project is located. If the PM_{10} standard is met for smoke and dust emissions, visibility should not be impaired in the Emigrant Wilderness or Yosemite National Park. These Class 1 airsheds are a minimum of 12 miles downwind from the project area. Smoke and dust would either not reach these areas, or would be in small, well-dispersed quantities which would not impair visibility.

Indirect Effects

No significant indirect effects are predicted.

Cumulative Effects

No cumulative effects are predicted. State regulations such as "burn days" help prevent emissions from multiple sources from causing cumulative effects.

Alternative 2

Direct Effects

Over the span of 4 years, 1,127 acres of broadcast burning for site preparation and 2,205 acres of broadcast burning for fire risk reductions to newly planted areas would occur. These activities would create smoke emissions, with effects similar to those of Alternative 1

Indirect Effects

No significant indirect effects are predicted.

Cumulative Effects

No cumulative effects are predicted. State regulations help prevent emissions from multiple sources from causing cumulative effects.

Alternative 3

Direct Effects

Over the span of 4 years, 456 acres of broadcast burning for site preparation and 2,205 acres of broadcast burning for fire risk reductions to newly planted areas would occur. The elimination of burning 671 acres reduces the potential for effects to air quality, compared to Alternatives 1 and 2.

Indirect Effects

No significant indirect effects are predicted.

Cumulative Effects

No cumulative effects are predicted. State regulations help prevent emissions from multiple sources from causing cumulative effects.

Alternative 4

Direct Effects

Over the span of 4 years, 2,205 acres of broadcast burning for fire risk reductions to newly planted areas would occur. This would create smoke emissions, with effects similar to those of Alternative 1.

Indirect Effects

No significant indirect effects are predicted.

Cumulative Effects

No cumulative effects are predicted. State regulations help prevent emissions from multiple sources from causing cumulative effects.

Alternative 5 (No Action)

Direct Effects

This alternative would not change the existing air quality conditions.

Indirect Effects

This alternative may have the effect of not reducing fuel loading, thereby affecting the potential for future wildfire which would have a significant effect on air quality.

Cumulative Effects

No cumulative effects are anticipated under this alternative.

If the PM_{10} standard is met for smoke and dust emissions, visibility should not be impaired in the Emigrant Wilderness or Yosemite National Park. These Class 1 airsheds are a minimum of 12 miles downwind from the project area. Smoke and dust would either not reach these areas, or would be in small, well-dispersed quantities which would not impair visibility.

B. Economic

This section summarizes the effects of the alternatives, in relation to Issue #2 in Chapter I, concerning comparative costs of reforestation treatments. A related economic issue is the cost associated with time and energy spent making certain that service contracts are implemented as intended. Contracts that utilize machinery, instead of hand labor, typically have lower operating costs and higher production rates. The impacts to the Ranger District are extremely pertinent. Any package of work that favors lower contract costs and higher production rates is viewed as beneficial to the workforce. This combination increases the likelihood of successful attainment of project objectives. While this is a general business principle, it is of even greater importance in this current period of reduced budgets.

Unestimated values associated with wildlife habitat created by the alternatives are not estimated here. Likewise, values associated with other resource outputs are not estimated. The absence of economic

values for these related alternative consequences decreases the values generated by present net value calculations.

Appendix 3, "Expected Timber Yields, Economic Costs and Returns," contains the background for the data summarized here.

Alternative 1:

Direct Effects:

Treatments to develop the forest structure in this alternative would cost approximately $6.7 million. Estimated direct employment is 189 jobs.

This alternative proposes the use of aerial application on 10,828 acres between 1994 and 1996, and the use of ground application by hand on 12,672 acres between 1994 and 1996. Aerial application, with its high production rates and lower unit costs, would require fewer days to accomplish and fewer people involved in contract supervision.

Indirect Effects:

Indirect employment is estimated to be 378 jobs.

Cumulative Effect:

The cost of project implementation, with the creation of jobs for contractors, add to the region's economy. This addition is probably only important locally.

Alternative 2:

Direct Effects:

Treatments to develop the forest structure in this alternative would cost approximately $6.7 million. Estimated direct employment is 189 jobs.

This alternative proposes the use of aerial application on 10,828 acres between 1994 and 1996, and the use of ground application by hand on 12,672 acres between 1994 and 1997. Aerial application, with its high production rates and lower unit costs, would require fewer days to accomplish and fewer people involved in contract supervision.

Indirect Effects:

Indirect employment is estimated to be 378 jobs.

Cumulative Effect:

Same as Alternative 1.

Alternative 3:

Direct Effects:

Treatments to develop the forest structure in this alternative would cost approximately $7.4 million. Estimated direct employment is 235 jobs.

This alternative proposes no aerial application and the use of ground application by hand on 23,520 acres between 1994 and 1997. Ground application would require more days and more people involved in contract supervision than Alternatives 1 and 2.

Indirect Effects:

Indirect employment is estimated to be 470 jobs.

Cumulative Effect:

Same as Alternative 1.

Alternative 4:

Direct Effects:

Treatments to develop the forest structure in this alternative would cost approximately $2.3 million. Estimated direct employment is 70 jobs.

Indirect Effects:

Indirect employment is estimated to be 140 jobs.

Cumulative Effect:

Same as Alternative 1.

Alternative 5:

Direct Effects:

This alternative would not expend any funds and would not create any employment opportunities.

Indirect Effects:

No indirect employment would occur.

Cumulative Effect:

No additional expenditure of funds and no additional employment occurs. No important future, wood product-related values are expected from this action.

C. Fire and Fuels

This section analyzes how the alternatives would reduce existing fuels, construct and maintain adequate fuelbreak systems and create fuel modification zones to reduce the potential of wildfire. It addresses Issue #4 in Chapter 1 on providing protection for the new forests.

The project area has already been salvage harvested and biomassed (removal of unmerchantable material), leaving the same fuel loading under any alternative. The number of acres proposed for reforestation under the different alternatives would further reduce, by that amount, existing fuels.

Alternatives 1 and 2 would reforest about the same number of acres with about the same fuel reduction effects. Alternative 3 would reforest 671 acres less. Alternative 4 would treat considerably fewer acres and reduce fuels proportionately less than Alternatives 1, 2 and 3. Alternative 5 would not reduce fuels below existing levels.

Fuel treatment objectives and organic matter retention do not necessarily conflict. Retaining adequate levels of organic material helps maintain long-term site productivity. To ensure adequate organic material retention throughout the rotation, the area must be protected from intense wildfires. Fine fuels spread wildfires; therefore fuels treatment to remove fine fuels, but retain larger organic material, is necessary.

In Alternative 1 and 2, broadcast burning is needed on 671 acres located on steep slopes with tall, dense brush. Those areas would be treated with aerial applications of hexazinone. Once unwanted vegetation is browned, the area would be burned using a helitorch. This would allow for planting access.

In Alternatives 1-3, broadcast burning is also needed on 456 acres to reduce the current fuel loading prior to planting. Broadcast burning would take place in parts of the following stands:

1994: Bear Springs: 46, 53, 54, 56, 58, 67

1995: Paper Cabin: 47, 48, 49, 50

Broadcast burning, for site preparation, would not be done in Alternative 4, as treatments are limited to acres already planted.

Fuelbreak System

The fuelbreak system remains the same under all alternatives. Creating and maintaining the fuelbreak system is independent of this proposed project.

A completed fuelbreak system, consisting of about 50 miles, or 1,186 acres, exists in the proposed project area. Fuelbreaks are located in the following stands:

Paper Cabin Compartment: 3, 8, 9, 10, 12, 13, 17, 19, 20, 22, 23, 25, 27-31, 33, 39, 41, 47-55, 57-61

Walton Cabin Compartment: 1, 2, 13-15, 18, 27, 28, 39, 40, 42-46, 48, 57-59, 61, 68, 69, 71-74, 80, 81, 85, 86, 96, 97, 99, 104, 105, 114, 122-131, 139, 141-145, 147, 152-161, 174, 176, 182-184, 188, 189, 259

Bear Springs Compartment: 58, 60, 61, 64, 67, 88, 97-100, 102, 106-108, 110-112, 116, 117,120, 140

Murphy Peak Compartment: 17, 18, 20-23, 31, 32, 37, 38

Fuel Modification Zones

All alternatives, except alternative 5 (No Action), would reduce fire spread potential, but to varying extents. This would be done by creating breaks in the continuous fuelbed, reducing fuel loading, and providing opportunities to create fuel diversity. Heavy fuel loading inhibits reforestation activities, and affects soil productivity by creating high intensity fires.

Alternative 1 emphasizes establishing conifer stands. During the first ten years after planting, stands would have low fire spread potential due to tree size and spacing. Beyond ten years these stands would become more vulnerable to rapid fire spread from added thinning slash, brush, and litter accumulation. Protection would result from proper fuelbreak placement, reduced fuel zones, access roads, adequate thinning, slash treatment, and brush treatment within the plantations.

Alternatives 1, 2 and 3 propose the use of herbicides to control competing vegetation. This treatment would reduce dense brush growth within conifer stands, which forms "ladders" for fire to reach tree crowns.

More acres are untreated in Alternatives 4 and 5. Alternative 4 provides for some conifer reestablishment; Alternative 5 provides none. Alternatives 4 and 5 do not propose use of herbicides. These alternatives would provide little opportunity for adequate protection needs for reforested areas. Implementation of Alternatives 4 and 5 would result in large, dense brush fields; conifer stands mixed with large, dense competing vegetation; and continuous fuel ladders. These conditions create fuel models that sustain very large wildfires.

Reforestation activities shorten the time required to change the existing average FBPS Fuel Model 8. Alternatives 3, 2 and 1, in that order, would create fuel mosaics that would reduce fuel continuity and protect resources in critical areas. Alternative 4 would somewhat reduce fuel continuity in the few treated areas, but would provide much less resource protection.

Alternative 5 would contribute little to creating more favorable fuel models. Fire killed areas not reforested undergo greater fuels buildup over time than do reforested areas. Re-burns of large fire areas occur about 10 to 20 years after the original fire. Using this estimate as a guide, the project area could burn again within 10 to 20 years under Alternative 5. In the near future, with light fuel accumulations on the forest floor (FBPS Model 8), fire spread would be limited by lack of fuel continuity. A low intensity fire damages reproduction and resprouted brush, but soil is minimally affected. As fuel loadings increase to those of FBPS Models 10 and 12, however, re-burning could result in a more high-intensity burn than the 1987 Stanislaus Complex Fire.

Alternative 5 would result in the greatest increase in lightening caused fires as well as suppression difficulties due to the higher snag densities. Under Alternative 5, ground fuels would remain unchanged and large dead trees and other dead above ground fuels (conifer tops, branches, hardwood trees, brush poles and pre-fire snags) would stand for the first few years. Fuel loading would increase over time as standing fuels start falling to the ground.

In order to protect stands from large and damaging wildfires, fuel modification zones need to be created. These areas are adjacent to plantations. Broadcast burning and underburning are needed in parts of the following stands which total 2,205 acres:

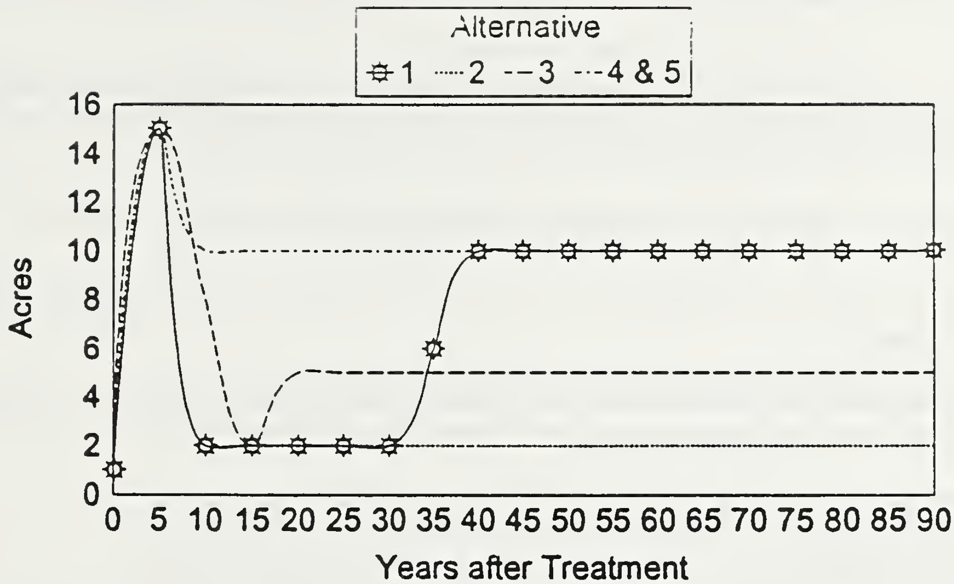
1994:	Bear Springs: 200, 202, 204, 206
1995:	Matsen: 2, 3, 4, 8, 19, 54, 55, 59, 60, 61, 62, 63, 84, 85 Paper Cabin: 123, 124, 125, 126
1996:	Paper Cabin: 51, 52, 53, 62, 63, 64, 65, 66, 67
1997:	Walton Cabin: 226, 227, 228, 229, 232, 233

Predicted Fire Size

Published fuel models and the Behave Computer Program predict the size of future wildfires. These follow vegetative changes occurring both naturally and as the result of salvaging various quantities of timber in given time periods.

The graph on the following page predicts fire size over time for each alternative. The assumptions used represent the conditions experienced on a late summer day with a light upslope wind (90 percent chance of occurrence).

Predicted Fire Size Over Time



These graphs predict fire size in acres, after 1 hour, based on time and alternative.

The graph on the previous page assumes no treatment during the 90 year rotation and considers the entire project area. Between 0 to 5 years, the fire size in all alternatives would have increased. Between 5 to 15 years each alternative would drop in fire size depending on the type of reforestation selected.

Alternatives 1, 2 and 3 would drop to 2 acres after 10 to 15 years, then increase over time. Alternative 1 would increase after 30 years due to growth within the reforested areas with less diversity, oak retention and fewer areas of open space. Fire size would level off after 40 years.

Alternative 2 would not change after 10 years, assuming growth and diversity in the reforested areas would create large fuel modification zones to keep fires small.

Some increases would occur in Alternative 3 compared to Alternative 2 after 15 years due to less treated acres overall.

Alternative 4 assumes some treatment without herbicide and Alternative 5 assumes no treatment. Both of these alternatives have the same predicted fire size over time.

Alternatives 1

Direct Effects

1. Reduced fire risk by broadcast burning within 2,205 acres outside of areas designated for reforestation.

2. Improved site preparation by broadcast burning within 1,127 acres.

3. Reduced fire spread potential by creating breaks in the continuous fuelbed, reducing fuel loading and providing opportunities to create fuel diversity.

Indirect Effects

1. Fuel breaks would increase soil productivity by reducing fire risks. Fire consumes organic matter which reduces nutrients and also soil cover. Intense fires can create hydrophobic soils which repel water and increase erosion.

2. In the early stages of reforestation, planted areas would reduce fire spread potential due to the lack of needle litter, the small size of conifers and the spacing between crowns. However, after 10 years reforested areas would become more vulnerable to rapid fire spread from added thinning slash, brush and litter accumulation.

3. Herbicides to control competing vegetation would prevent brush species from growing tall and dense, a fire hazard within reforested areas.

Cumulative Effects

This alternative would create fuel mosaics that would reduce fuel continuity and protect resources.

Alternative 2

Direct Effects

1. Reduced fire risk by broadcast burning within 2,205 acres outside of areas designated for reforestation.

2. Improved site preparation by broadcast burning within 1,127 acres.

3. Reduced fire spread potential by creating breaks in the continuous fuelbed, reducing fuel loading and providing opportunities to create fuel diversity.

Indirect Effects

1. Fuel breaks would increase soil productivity by reducing fire risks. Fire consumes organic matter which reduces nutrients and also soil cover. Intense fires can create hydrophobic soils which repel water and increase erosion.

2. In the early stages of reforestation, planted areas would reduce fire spread potential due to the lack of needle litter, the small size of conifers and the spacing between crowns. However after 10 years, reforested areas would become more vulnerable to rapid fire spread from added thinning slash, brush and litter accumulation. Also, the greater diversity of vegetation due to retaining more oak emphasis would provide greater opportunities to establish fuelbreaks and reduced fuel zones than in Alternative 1.

3. Herbicides to control competing vegetation would prevent bush species from growing tall and dense, a fire hazard within reforested areas.

Cumulative Effects

This alternative would also create fuel mosaics, serving to reduce fuel continuity, protect resources and the District's investment in reforestation.

Alternative 3

Direct Effects

1. Reduced fire risk by broadcast burning within 2,205 acres outside of areas designated for reforestation.

2. Improved site preparation by broadcast burning within 456 acres.

3. Reduced fire spread potential by creating breaks in the continuous fuelbed, reducing fuel loading and providing opportunities to create fuel diversity.

Indirect Effects

1. Fuel breaks would increase soil productivity by reducing fire risks. Fire consumes organic matter which reduces nutrients and also soil cover. Intense fires can create hydrophobic soils which repel water and increase erosion.

2. In the early stages of reforestation, planted areas would reduce fire spread potential due to the lack of needle litter, the small size of conifers and the spacing between crowns. However, after 10 years, reforested areas would become more vulnerable to rapid fire spread from added thinning slash, brush and litter accumulation. Also, the greater diversity of vegetation due to eliminating treatment on 671 acres and providing the same oak emphasis on remaining acres as Alternative 1, would provide more opportunities to establish fuelbreaks and reduced fuel zones.

Cumulative Effects

This alternative would also create fuel mosaics, serving to reduce fuel continuity.

Alternative 4

Direct Effects

1. Reduced fire risk by broadcast burning within 2,205 acres outside of areas designated for reforestation.

2. A reduction in fire spread potential due to the breaks in continuous fuelbed as in Alternatives 1, 2 and 3. This alternative would treat considerably fewer acres and reduce fuels proportionately less than Alternatives 1, 2 and 3.

Indirect Effects

Alternative 4 would result in large, dense brush fields, and a few conifer stands mixed with large, dense competing vegetation and continuous fuel ladders would create conditions that sustain large wildfires.

Cumulative Effects

Create fuel mosaics that would reduce fuel continuity and protect resources in critical areas, but to a much less extent than Alternatives 1-3.

Alternative 5

Direct Effects

This alternative would contribute little to a more favorable fuel model. Fire killed areas not reforested undergo greater fuels buildup over time than do reforested areas. Re-burns occur about 10 to 20 years after an original fire. Therefore, the project area could burn again within 10 to 20 years.

Indirect Effects

1. Ground fuels would remain unchanged and large dead trees and other dead above ground fuels would stand for the first few years. Fuel loading would increase as they begin to fall to the ground.

2. Continuous fuel ladders would be created as the area becomes large, dense brush fields that compete with conifers.

Cumulative Effects

This Alternative has the greatest potential for increased lightening caused fires as well as suppression difficulties due to the higher snag densities. A low intensity fire would damage reproduction and resprouted brush, but soil would be minimally affected. As fuel loadings increase to those of NFFL Models 10 and 12, reburning could result in a more high-intensity burn than the 1987 Stanislaus Complex Fire.

D. Heritage Resources

This section analyzes the effects of alternatives in relation to Issue #5 in Chapter 1 on how reforestation activities would protect MeWuk values and traditions and how the project would affect areas that could be eligible for the National Register of Historic Places.

All reforestation contracts protect cultural resources, including those discovered during operations. Before land-disturbing activities can occur, the project must comply with Section 106 of the National Historic Preservation Act; Region 5 Fire Recovery Programmatic Agreement; and the Region 5 Timber Management No Effect Memorandum of Understanding.

An inventory of cultural resource properties has been completed. Sites may require protection in accord with 36CFR 800 and other historic preservation laws, rules and orders.

The Forest's primary mitigation for protecting cultural properties is to conduct all activities outside site management boundaries. If a site management boundary cannot be avoided, the Forest Archaeologist reviews the case and decides what action to take.

If the PA and FRHPTP offer no suitable treatment and if a site cannot be avoided, the property is evaluated for its eligibility to the National Register of Historic Places. If the property is eligible, the adverse effects on the property are determined and mitigated in compliance with Section 106 of the NHPA. If the property is ineligible, the Forest Service would attempt mitigation, meanwhile maintaining the option to remove the property from further management.

Known sacred or religious sites are protected in accord with the American Indian Religious Freedom Act (P.L. 95-341). This Act charges Federal agencies with the responsibility of evaluating "...policies and procedures in consultation with traditional religious leaders in order to determine appropriate changes necessary to protect and preserve Native American cultural rights and practices." This perpetuates the traditionally used flora and fauna as encouraged by Forest Service resource management.

Alternatives 1-3

Direct Effects

1. As no sites are involved in the project, there are no effects on known sacred or religious sites.

2. The Mi-Wok Ranger District will conduct ongoing communication with the MeWuk to address their concerns regarding the acorn, mushroom, nutmeg and wild onion collection areas and the traditional hunting areas used by the MeWuk (refer to Chapter III, Heritage Resources).

Indirect Effects

1. Effects of herbicides on radiocarbon dating of artifacts remains unknown. No information exists to substantiate concerns.

2. Broadcast burning may affect historic artifacts and structures not detected in surveys.

3. Planting potentially affects subsurface sites by digging holes about 4-6" across and 12-18" deep.

Cumulative Effects

There are no known significant adverse effects from these alternatives.

Alternative 4

Direct Effects

There are no known adverse effects

Indirect Effects

1. Cutting, scraping and grubbing rootwads to control competing vegetation removes surface soil and tools may damage buried artifacts.

2. Planting potentially affects subsurface sites by the digging holes about 4-6" across and 12-18" deep.

Alternative 5

1. This alternative would have no adverse effects on heritage resources.

E. Human Health and Safety

This section is divided into two parts, based on the use of herbicides. First the effects of herbicide applications under Alternatives 1, 2 and 3 will be discussed, followed by the manual effects of Alternative 4. This section analyzes the effects of the alternatives in relation to Issue 6 in Chapter 1, "How is human health affected by the use of herbicides during reforestation activities?"

Alternatives 1, 2 and 3: Use of Herbicides

To analyze the effects of herbicides on human health a site-specific risk assessment was completed (see Appendix 1) that uses standard methodology. The assessment examines risks from three herbicides proposed for controlling vegetation: hexazinone (Pronone 10G and Velpar L), glyphosate (Accord) and triclopyr (Garlon 4).

When chemical methods are utilized (Alternatives 1, 2 and 3) the potential effects become somewhat more complicated to analyze. See pages 4-62 to 4-123 of the VMFEIS for a summary of the Regional risk assessment.

A risk assessment was completed to assess the site-specific risks to human health and safety of using the herbicides triclopyr (Garlon 4), hexazinone (Pronone 10G and Velpar L), and glyphosate (Accord) for vegetation management for site preparation and release of subsequent conifer plantations on the Mi-Wok Ranger District, Stanislaus National Forest (see Appendix 1). This analysis is based on the *actual* planned average application rates for each of the three herbicides that are proposed for hand and aerial application (See Appendix 1, Table 1-1). The following table summarizes the actual herbicide formulations that are planned for use, the application rates per acre, and the additives planned for use:

Table IV-1- Herbicide Formulations, Application Rates and Additives

Herbicide Formulation	*Application Rate/Acre*	*Additives*
Garlon 4 (triclopyr)	1.0 lb/acre	MOR-ACT or R-11, colorant
Accord (glyphosate)	1.5 lbs/acre	MOR-ACT or R-11, colorant
Pronone 10G (hexazinone)	3.5 lbs/acre	None
Velpar L (hexazinone)	3.5 lbs/acre	colorant

Note: MOR-ACT and R-11 are spreader/activators, they improve the activity and penetration of the herbicide, while reducing surface tension allowing the liquid to spread evenly.

The site-specific risk assessment uses standard methodology widely accepted by the scientific community, regulatory agencies, and the Forest Service (VMFEIS, pages 4-62 to 4-122 and Appendix 1). In essence, the risk assessment compares herbicide doses that people might receive from applying the herbicides or from being near an application site with doses shown to cause no observed ill effect (NOEL) in test animals in long-term laboratory studies. The risk assessment examines the chance, based on site-specific herbicide use levels, that exposures from these herbicide formulations would result in acute, systemic, or reproductive effects or cause cancer.

The site-specific risk assessment also examines the potential for these treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals including women and children.

Hazard analysis was accomplished by reviewing toxicity data in the literature and the FEIS and identifying established acute toxicity values (LD_{50}), NOELs for systemic and reproductive health effects, and cancer potency for each herbicide proposed for use (see VMFEIS, Appendix F, Table F-41). Based on the acute toxicity values, all of the herbicides proposed for use are classified as only slightly toxic to humans and other mammals.

Based on site-specific herbicide use levels, doses were calculated for potentially exposed workers and members of the public and are displayed in Tables 1-2 through 1-5 in Appendix 1. **All doses are at low levels.**

A margin of safety (MOS) was calculated for each dose estimate for workers and members of the public by dividing the systemic and reproductive NOEL of each herbicide by the estimated dose. A benchmark MOS of 100 is commonly accepted by the scientific community, regulatory agencies, and the Forest Service for setting acceptable dose levels. MOS values of 100 or greater are considered to pose an acceptable or low risk to human health. **All MOS values calculated for doses resulting from the proposed site-specific herbicide treatments are equal to or greater than 100 (see Tables 1-2 through 1-5 in Appendix 1). Based on the benchmark value, all proposed applications pose an acceptable or low risk to human health and safety.**

For cancer risk we assume that any dose, no matter how small, has some probability of causing cancer. To estimate the lifetime cancer risk for an individual exposed to a herbicide we need to know the cancer potency value of the herbicide and the individual's lifetime average daily dose of the herbicide.

Based on the weight-of-evidence, the Environmental Protection Agency has chosen not to determine a cancer potency value for hexazinone, but to establish instead, a reference dose (RfD) of 0.05 mg/kg/day (Rinde and Dykstra 1992). Calculated doses to workers and members of the public were compared to the RfD to assess risk of cancer from hexazinone treatments. Based on the required use of protective clothing by workers and the calculated exposures to members of the public, the proposed use of hexazinone presents negligible risk of cancer to members of the public and to workers.

The negligible risk of cancer from hexazinone treatments includes exposure from brown-and-burn operations. The health risks from potentially toxic burning products of the hexazinone are even lower than exposure during applications because the amount of the parent material is lower after two months; and of the material burned, the combustion products of concern would constitute a minute fraction of the total volume of released products (R5-FEIS, Appendix F, page F-90). In addition, a field study involving a prescribed burn where Pronone 10G was used revealed no residues in smoke samples (McMahon and Bush, 1991).

The cancer potency of a given herbicide is defined as the increase in likelihood of getting cancer from an increase in the dose of the herbicide. Cancer potency values reflect the probability or chance of getting cancer sometime in a person's lifetime for each mg/kg/day of a chemical that a person is exposed to. Of the herbicides proposed for this project, only glyphosate has an associated cancer potency value (see VMFEIS, Appendix F, Table F-41).

The lifetime average daily dose (LADD) is a product of the estimated daily dose resulting from a given type of public exposure or type of work times the number of days that the exposure occurs divided by the total number of days in a lifetime.

Following the same methodology used in the VMFEIS, lifetime cancer risk values were calculated for the general public and workers (Appendix 1, Tables 1-6 and 1-7). The cancer risk for forest users is less than 1 chance in 100 million (Appendix 1, page 13). Nearby residents have a cancer risk of 1 chance in 30 million. Hikers (backpackers) have the highest calculated cancer risk of about 1 chance in 4 million. **Based on the benchmark value of 1 in 1 million, the proposed treatments of glyphosate appear to present a negligible risk of cancer to the general public.**

Lifetime cancer risk values were also calculated for workers. (Appendix 1, page 14). If a worker were to be an applicator for all glyphosate applications over the four year period for this project, that worker could be exposed to glyphosate a maximum of 210 days over the duration of the project. This one-time exposure of 210 days was compared against the 30-year career exposure. The lifetime individual cancer risk value calculated for each applicator based upon a one-time exposure resulting from this project is about 1 chance in 7 million, much less than 1 in 1 million.

The cumulative risk of glyphosate applications for 30 years over a 70 year lifetime would pose a risk of about 1.1 in 1 million for workers applying glyphosate for 60 days each year, assuming that the workers would make these same treatments during that time period. The probability of this scenario occurring is low because most people change jobs during a 30-year career. If the crew size were doubled to complete the project in half the time, exposures and cancer risk would be half.

Risks of cancer that are 1 in 1 million or less are considered to pose a negligible risk (VMFEIS, page 4-63). All of the values calculated in this analysis are much less than 1 in 1,000,000. The only established risk level in the State of California is found within the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65), and defines no significant cancer risk as "...one excess case of cancer in an exposed population of 100,000 ..." All the cancer risk values calculated for this analysis are much lower than the State standard. **Lifetime cancer risks to members of the public and to workers resulting from exposures to the proposed use of glyphosate in this project are very low.**

At maximum, the number of forest visitors and forest workers exposed to these very low risks would be less than the estimated maximum numbers of forest visitors to the general locations (400) and the estimated maximum numbers of forest workers (150). Exposure would be reduced by:

1. Signing of treatment units prior to treatment
2. Requiring Forest Service personnel administering contract to wear protective clothing, and
3. Strictly enforcing State of California Department of Food and Agriculture regulations regarding protective clothing (refer to Section II.B).

Synergistic Effects

Synergistic effects (multiplicative) are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive). See pages 4-111 through 4-114 in the VMFEIS for a detailed discussion on synergistic effects.

Instances of chemical combinations that cause synergistic effects are relatively rare (VMFEIS, page 4-112). Review of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicates that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (Kociba and Mullison 1985, Couch et al. 1983, EPA 1986). Synergism generally has not been observed in toxicological tests involving combinations of commercial pesticides.

The herbicide mixtures proposed for this project have not shown synergistic effects in humans who have used them extensively in forestry and other agricultural applications. However, synergistic toxic effects of herbicide combinations, combinations of the herbicides with other pesticides such as insecticides or fertilizers, or combinations with naturally occurring chemicals in the environment are not normally studied. Based on the limited data available on pesticide combinations, it is possible,

but quite unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis.

However, even if synergistic or additive effects were to occur as a result of the proposed treatments, these effects are dose responsive (Dost 1991). This means that exposures to the herbicide plus any other chemical must be significant for these types of effects to be of a biological consequence. **Based on the very low exposure rates estimated for this project as shown in Tables 1-2 through 1-5 in Appendix 1, any synergistic or additive effects are expected to be insignificant. Even for the planned combination of herbicides, the risk to human health and safety is within acceptable levels.**

Inert Ingredients

The risk assessment in Appendix 1 has characterized human health risks by comparing estimated herbicide doses with toxicity levels found in laboratory animals. The toxicity data are based on the active ingredient found in the herbicide formulations. The formulations also include chemicals called inert ingredients which act as carriers for the active ingredients and facilitate the effective application of the herbicides. Additional additives may also be included in the mixture, including stickers or colorants. Concern about the possible toxic properties of the inert ingredients and the full formulation was expressed during public involvement for the Regional VMFEIS.

The issue concerning inert ingredients and the toxicity of formulations is discussed in the VMFEIS (pages 4-116 to 4-119). The approach used in the VMFEIS and the site-specific analysis to assess environmental effects of inert ingredients and full formulations has been to: (1) compare acute toxicity data between the formulated products (including inert ingredients) and their active ingredients alone; (2) disclose whether or not the formulated products have undergone chronic toxicity testing; and (3) identify, with the help of the Environmental Protection Agency (EPA) and the chemical companies, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients. Researchers have studied the relationships between acute and chronic toxicity and while the biological end-points are different, relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise 1984). The court in *NCAP v. Lyng*, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decisionmaker to make a reasoned decision. In SRCC v. Robertson, Civ. No.s-91-217 (E.D. Cal., June 12, 1992), the district court upheld the adequacy of the VMFEIS's methodology for disclosure of inert ingredients and additives.

Comparison of acute toxicity (LD_{50} values) data between the formulated products (including inert ingredients) and their active ingredients alone shows that the formulated products are generally less toxic than their active ingredients glyphosate, hexazinone and triclopyr (VMFEIS, pages 4-117 to 4-119; Monsanto Company 1987; USDA Forest Service 1984).

Thus far, the chemical companies and the EPA review have identified two ingredients of toxicological concern in the Garlon 4 formulation of triclopyr (see Table 1-12, Appendix 1). These ingredients are kerosene and 2-butoxyethanol (VMFEIS 4-117 and Dow Chemical USA 1988). Kerosene is used as a carrier for the triclopyr formulation while 2-butoxyethanol (EGBE) is a manufacturing impurity.

The Forest Service evaluated the health risks associated with kerosene and the impurity EGBE in Garlon 4 herbicide formulation (VMFEIS, page F-77; Borrecco and Neisess, 1991). The risk assessments show that the addition of kerosene and EGBE found in Garlon 4 formulation does not increase the risk to human health over the risk identified for the active ingredient triclopyr.

The use of the surfactants Mor Act or R-11 and/or colorants was included in the site-specific risk assessment for this project. None of the ingredients in these products are of toxicological concern (see Appendix 1). Information used in the assessment was obtained from the EPA and the manufacturers. Based on the chemical nature of the ingredients, only very slight toxicity is expected. The use of these additives in the formulations would result in little risk to the health and safety of workers or the public.

While these formulated products have not undergone chronic toxicity testing like their active ingredients, the acute toxicity comparisons, the EPA review, and our examination of toxicity information on the inert ingredients in each product lead us to conclude that the inert ingredients in the Accord, Pronone 10G, Velpar L and Garlon 4 formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients. **Health risks from the inert ingredients and the full formulations of the proposed treatments are low.**

Sensitive Publics

Appendix 1 contains a detailed discussion of the potential to adversely affect members of the sensitive public (i.e., women, children, and chemically sensitive individuals). See pages 4-114 through 4-116 in the VMFEIS for a detailed discussion on sensitive populations.

The margin-of-safety approach used in this risk assessment takes into account much of the variation in human response. In essence, the benchmark of 100 reduces the NOEL values by ten to account for differences between laboratory animals and humans, and by another factor of ten to account for variation among humans. The normal MOS of 100 is sufficient to ensure that most people will experience no toxic effects.

"Sensitive" individuals are those that might respond to a lower dose than average. Individuals that may be sensitive to herbicides may not be covered by an MOS of 100 because human susceptibility to toxic substances can vary by two to three orders of magnitude. Factors affecting individual susceptibility include diet, age, heredity, preexisting diseases, and lifestyle. Individual susceptibility to the herbicides proposed in this project cannot be specifically predicted. Unusually sensitive individuals may experience effects even when the MOS is equal to or greater than 100. Because only a very small portion of the public is likely to be exposed to these applications, and because MOS values are much greater than 100 (430 to 9 million) for public exposures; adverse effects to sensitive individuals are not expected.

Health Advisories (HA) developed by the Office of Drinking Water, EPA provide another approach to assess health risks to sensitive individuals. Health Advisories describe concentrations of contaminants in drinking water at which adverse health effects are not anticipated to occur over specific exposure durations. Health Advisories contain a 100-fold margin of safety to protect sensitive individuals in a population, which include women and children; the longer-term and lifetime HAs provide estimates of an acceptable daily intake. For each proposed herbicide in this project, a lifetime HAs was calculated for both men and women based on different average body weights, and a long-term HA was calculated for small children (Appendix 1). All calculated doses to members of the public and workers (Tables 1-2 through 1-5, Appendix 1) are less than the HA values calculated for men, women, and children.

Based on the Health Advisories and calculated MOS values from Tables 1-2 through 1-5 in Appendix 1, the proposed herbicide treatments pose a low risk to women, children and other sensitive individuals.

Transportation, storage and disposal of herbicide containers

The transportation, storage and disposal of herbicide containers will be accomplished in accordance with California Department of Food and Agriculture established regulations and California Code of Regulations, Subarticle 10, Pesticide Storage, Transportation and Disposal, Section 6884, Transportation, and Section 6884, Rinse and Drain Procedures. Rinsing procedures will conform with California Code of Regulations Subarticle 10, Section 6684. The rinse water shall be disposed of by placing it in the batch tank and applying it to the vegetation on the unit. Used and rinsed containers shall be punctured on the top and bottom to render them unusable. A log of the containers, recording how they were rinsed and disposed of, shall be kept by the contractor and made available to the Contracting Officer. Certification of disposal at an approved dump site (conforming with California Code of Regulations, Subarticle 10, Section 3142) is required prior to final contract payment. In addition, the containers that are disposed of at an approved dump site are not considered a hazardous solid waste (California Code of Regulations, Title 23, Chapter 3, Subchapter 15, Section 2523, Nonhazardous Solid Waste).

Cumulative Effects

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Cumulative doses of the same herbicide result from (1) additive doses resulting from various routes of exposure from this project and (2) additive doses if an individual is exposed to other herbicide treatments. The additive doses from various routes of exposure resulting from this project have already been considered in the risk assessment (see Appendix 1.)

Additional sources of exposure could include: use of herbicides on adjacent public or private lands, re-treatment of the same site in the same or following year, or home use by a worker or member of the general public.

Information provided informally by a major private timber company with land adjoining the project area (Fibreboard) and the Tuolumne County Agricultural Commissioner's records indicate that applications of glyphosate, triclopyr and hexazinone have occurred over the last five years within the project area. One application of glyphosate on 150 acres and one of triclopyr on 640 acres are planned within the next five years on Fibreboard land. The Tuolumne County Agricultural Commissioner's office was not aware of any additional plans for applications on private land within the project area as of August, 1993.

There have been two applications of herbicides on National Forest adjacent to the project area within the last five years. These were both applications of a tank mixture of glyphosate and triclopyr for release on 895 acres, and were called the Paper Cabin Release project. The applications occurred in 1992 and 1993. There are no applications planned on National Forest within the analysis area beyond what is listed in the description for Alternatives 1, 2 and 3. Since these herbicides persist in the environment for less than 12 months (VMFEIS, page 4-9), do not bioaccumulate, and are rapidly eliminated from the body (Dost, 1991), and the applications planned on private property are for relatively small areas for one application only, additive doses would not be significant.

For this proposed project, three treatment scenarios are proposed under Alternatives 1, 2 and 3. Most of the units would be treated with hexazinone in the winter of the first year and a tank mix of glyphosate/triclopyr in the summer of the second year. The remainder of the units would be treated with either 1) a tank mix of glyphosate/triclopyr in the spring of the first year of treatment, followed by a second application of glyphosate/triclopyr in the summer of the second year or 2) a spring application of glyphosate, followed by a second application in the summer of the same year with a

tank mix of glyphosate/triclopyr, and a third treatment the following year with a tank mix of glyphosate/triclopyr.

A worker or a member of the general public could be exposed to the additive dose of the new application plus any residual herbicide remaining on the site from the initial treatment. For example, if no degradation of the glyphosate is assumed (an obvious over-exaggeration of the risk), the maximum exposure to a backpack applicator would be the dose for walking through the treated areas plus the dose from the second application (see Table 1-8). Using the HI model described in the section on synergistic effects, the additive MOS values for the spring glyphosate/summer glyphosate-triclopyr scenario would be 210 for systemic and 130 for reproductive. Since some of the herbicide would have degraded during the time between the first and second applications in both treatment scenarios, workers are required to wear protective clothing, and the unlikelihood that the same individual would actually be involved in two subsequent applications, actual doses are expected to be much lower, resulting in greater MOS values.

If workers or members of the public use herbicides at home, this could result in doses equivalent to those estimated for this project if similar application rates are used. This was considered to be an unlikely scenario, based on the remote location of the proposed treatment units, the ruggedness of the terrain and the fact that the applicators are typically non-local. If a person were to apply glyphosate around their home, the additive dose might be as high as 0.044 mg/kg/day (Table 1-3 in Appendix 1). If this exposure were to occur on the same day as the proposed project, then this dose would be added to the estimated dose resulting from the project and compared to the NOEL to determine the MOS. If this cumulative dose were to occur, the lowest MOS would be about 66. Hexazinone is currently not available for use by homeowners, and it was considered unlikely that additional applications would be made on private forest land or ranch land. In all cases, the use of protective clothing at the job site or at home would reduce the dose.

For all instances, cumulative effects would be negligible with the exception of where individuals use herbicides at home on the same day of a previous exposure resulting from this proposed project. In these latter cases, the human health risks could double.

For cumulative cancer risks, any increase in days exposed or in the rate of herbicide applied will increase the dose and the lifetime cancer risk. For example, a worker who is exposed to glyphosate as a result of this project has a lifetime cancer risk of about 1 chance in 11 million (based on an application rate of 1.5 lbs/acre). If that same individual were to work on an additional project with the same application rate and for the same number of days (i.e, same exposure), then the cancer risk would be double. The risk assessment also estimated cumulative cancer risks of 1.1 chances in 1 million (see Cancer Risk section), if it were assumed that workers did the same type of work 60 days each year for a period of 30 years. As was stated earlier, this is an unlikely scenario.

Cumulative cancer risks to the general public have already been accounted for in the calculations of cancer risk in the risk assessment. For each type of forest user (such as a hiker), we have assumed the individual is exposed each and every day they participate in that activity, regardless of whether they are on public or private lands. The cumulative or lifetime cancer risk to the public was estimated to range from 1 in 4 million to 1 in 100 million.

Alternative 4: Manual Reforestation Methods

Alternative 4 has a low risk to human health and safety for the general public as a result of using manual methods of reforestation. There are greater risks for workers. The workers have risk associated with injuries and accidents from using hand tools and equipment.

Manual methods of treating competing vegetation present some level of risk to human health and safety. The VMFEIS contains a detailed discussion on human health and safety and is incorporated by reference. (See pages 4-55 to 4-122 and Appendix F, pages F-1 to F-173).

Manual methods proposed for this project include scalping and hand grubbing with hand tools, and cutting brush and trees with chainsaws. The risk of injury to members of the public from these methods is low because the public is not likely to come close enough to workers to be injured when these hand tools are being used (VMFEIS, page 4-58). Workers could be cut by tools, hit by falling brush, or injured by a fall onto sharp stumps or ends of cut brush. Injuries could range from minor cuts, sprains, bruises, and abrasions to severe injuries such as major arterial bleeding, bone fractures, or concussions. A severe injury may even kill a worker (VMFEIS, page 4-56). Other types of health effects might include fatigue, heat exhaustion, heat stroke, tendon or ligament damage, aggravation of arthritis, heart attack, or stroke. The likelihood of injury increases as slope, brush density, brush height, and crew size increases, and when a crew works in a relatively concentrated area (VMFEIS, pages 4-56 to 4-57).

The likelihood of injury per worker-hour has not been formally calculated on a large scale in conjunction with manual removal of brush or the placement of mulch mats. Several approaches may be used to arrive at estimates. Bernstein (1979) reported a frequency of 1 minor injury per 13 worker-days with no major injuries, based on 265 worker-days of brush removal. The same crew sustained a rate of 1 injury per 25 worker-days during precommercial thinning, and there was a general feeling that brush removal was a more hazardous undertaking than thinning associated with hardwood control. Roberts (1980) reported only minor accidents in 30 worker-days of brushing, with one near-miss of a serious eye injury. Again, workers regarded brushing as above average in hazard. Richard Koven (Dow, 1981) testified during the 2,4,5-T Rebuttable Presumption Against Registration (RPAR) hearings, based on a listing of injuries reported by the Northwest Forest Workers Association, that the workers experienced 29.35 hours of lost-time injuries per 100,000 hours worked and 46.96 injuries per 100,000 hours worked. He stated, "It is the belief of the Association that these rates reflect a relatively safe work situation."

The Workers Compensation Rating Bureau of California lists the following rates for forest workers (R5-FEIS, p. 4-57):

Type of Work	Rate per $100 of Payroll*
Handtools/chainsaws	$19.88
Hand applied herbicides	$8.10
Aerially applied herbicides (pilots)	$13.65
Aerially applied herbicides (ground crew)	$6.76

*A lower value indicates lower risk.

"Although this is a very limited data base to draw any firm conclusions, indications are that there is a risk to workers doing manual vegetation management work, although it is estimated that the risk is low. This risk increases as the slope, brush density, and brush height increase." (VMFEIS, Chapter 4, page 4-57).

In addition, the Mi-Wok Ranger District has accomplished many hand grubbing contracts since 1987 and has not had any injuries to workers reported.

See page 4-58 of the VMFEIS for Vegetation Management for Reforestation for a risk discussion on the effects on human health and safety for using mechanized equipment.

Alternative 5: No Action

This alternative has no risks to human health and safety as no vegetation management would be undertaken.

F. Range

Alternative 1

Direct Effects

This alternative calls for using aerial and ground herbicide applications to reforest 11,750 acres of capable, available and suitable land.

Within the Duckwall Allotment 1,651 acres would be treated, representing about 9 percent of the total allotment, including National Forest and private land. Within the Hunter Creek allotment, another 10,099 acres would be treated, representing roughly 33 percent of the total allotment, including National Forest and private land.

Alternative 2

Direct Effects

Alternative 2 would reforest 11,750 acres of capable, available and suitable land, using aerial and ground herbicide applications.

Within the Duckwall allotment 1,651 acres would be treated, representing about 9 percent of the total allotment, including national forest and private land. Within the Hunter Creek allotment, another 10,099 acres would be treated, representing roughly 33 percent of the total allotment, including national forest and private land.

Alternative 3

Direct Effects

Alternative 3 would reforest 11,079 acres of capable, available and suitable land, using only ground applications of herbicides. Under this alternative, steep slopes with high brush, consisting mostly of deer brush, would be eliminated from the project.

Within the Duckwall allotment 1,640 acres would be treated, representing about 9 percent of the total allotment, including National Forest and private land. An added 164 acres within the Duckwall allotment that naturally regenerated would also be treated by handgrubbing. Within the Hunter Creek allotment, another 9,439 acres, or roughly 31 percent, would be affected by the project.

Alternative 4

Direct Effects

This alternative would not use herbicides. Activities are limited to hand releasing acres that have already been deeptilled and planted. There are 512 acres within the Duckwall allotment that would be treated using this method, representing about 3 percent of the total allotment, including National Forest and private land. Another 3,268 acres, or roughly 11 percent, of the Duckwall allotment would be treated.

Alternative 5

Direct Effects

This is the no action alternative, which would have no effects on either allotment.

Alternatives 1-3 (herbicide use)

Direct Effects

Triclopyr and hexazinone have grazing restrictions. Where applications of trip-clopyr exceed two quarts per acre or where more than 25 percent of the grazed area is treated, cattle are required to be removed three days prior to slaughter. Generally, the earliest that cattle are taken off an allotment is September 1st. The label for hexazinone requires that cattle be kept off treated range for 30 days after application. For this project, the contracts for hexazinone would require application in March, allowing more than 30 days before the cattle are put on the allotments, typically on May 15.

There are no direct adverse effects to livestock with these alternatives. Livestock grazing studies on the herbicides proposed for use have been completed and subsequent chemical tolerances have been established by the Environmental Protection Agency and were published in the Federal Register.

Indirect Effects

1. There would be no significant adverse health effects on cattle due to cattle eating vegetation treated with herbicides.

Glyphosate has no label restrictions regarding the type of cow-calf livestock grazing that occurs on the allotments (Accord Specimen Label, 1988).

Hexazinone's label restricts grazing within 30 days of treatment. Since hexazinone would be applied in March, its use either has no effect, or it may delay the grazing season up to 30 days beyond the usual mid-May entry date. There would be no reduction of animal months grazed.

Triclopyr's (Garlon 4) label excludes grazing for one year following treatment, if Garlon 4 is applied at 1.5 quarts per acre or more. If it is applied at a rate of less

than 1.5 quarts per acre, there is no grazing restriction. (Specimen Label 86-1471, Dow Chemical Company.) Garlon would only be applied at rates less than 1.5 quarts per acre within Hunter and Duckwall allotments.

None of the surfactants and other substances mixed into the proposed herbicide sprays have grazing restrictions.

2. In the absence of other kinds of forage, cows will eat bearclover. In Alternatives 1-3, the amount of bearclover would be reduced since it is a type of unwanted vegetation that would be controlled by herbicide. In Duckwall allotment, the forage lost on the 1,651 or fewer treated acres would not be enough to affect the term permitted livestock numbers or season. In Hunter Creek allotment, there would be a greater loss of forage vegetation. At this time, the permit issued is on a temporary status.

3. Salt licks and water supplies would be moved from treated areas to encourage movement of cows away from treated areas. Wet Meadow Spring, Walton Cabin Spring, and Indian Spring would be unaffected by treatment.

4. The herbicide applications would remove older unwanted vegetation allowing the resprouting of new grasses and forbs and re-seeding of shrubs which provide forage for cattle.

Cumulative Effects

If unwanted vegetation is eliminated in this project area and other Districts, the amount of available forage within and beyond the Paper Fire reforestation project would decrease.

Alternative 4

Direct Effects

Most of the existing forage on 3,944 acres would be temporarily eliminated by hand grubbing. Compared to Alternatives 1-3, fewer acres would be treated for planting and release.

Indirect Effect

If unwanted vegetation is eliminated in this project area and other Districts, the amount of available forage within and beyond the Paper Fire reforestation project would temporarily decrease.

Cumulative Effects

The extent of cumulative effects depends on suitable range acreages and timing of site preparation and release with this project and similar reforestation project(s) within the Stanislaus Forest range lands.

Alternative 5

Direct Effects

No actions would be taken that would affect the current natural progression of vegetation recovery.

Indirect Effects

Forage vegetation would remain on the grazing allotments, however some of the acres would become unsuitable as unpalatable shrubs like bearclover and manzanita grow and replace grasses and forbs.

Cumulative Effects

Alternative 5 would add no cumulative impacts to the acres being analyzed or to the allotments containing the acres.

G. Recreation and Scenic

The following comparative analysis responds to Issue 8 in Chapter I concerning how reforestation would affect recreation and scenic values.

The 1987 firestorm changed the view of the area from generally forested to a landscape of hardwoods and shrubs. The area features no tourism destination points of high public interest. The present lack of shade due to the loss of trees has further reduced the area's present recreational opportunities. The remote setting remains conducive to hunting and ORV users, and may serve a small number of backpackers and day-hikers. Recreational activities that occur in this area include photography, hiking, fishing, pleasure driving, camping, and wildlife and nature viewing.

The visual effects of reforestation vary by alternative. In summary, Alternative 1 would plant conifers over expansive areas that would appear as open areas dotted with the resprouting and/or surviving hardwoods. This would change as the conifers increase in size and join the hardwoods as visible members of the plant community. In the long term, Alternative 1 is more desireable than Alternatives 4 and 5, since it would result in a forest setting that is preferable for many recreation activities.

Alternative 2, like Alternative 1, is preferable to Alternatives 4 and 5, since it would create a forest setting preferable for recreation activities. The emphasis on oak management would also contribute to a greater visual mosaic effect than Alternative 1.

Alternative 3 would place the same emphasis on deer winter range as Alternative 2. The approximately 671 acres that would not be treated would result in the continued development of large brushfields dotted with hardwoods in several areas. This would add variety to the overall picture, but the areas are not always visible throughout the burn area.

Alternative 4 would create less extensive short-term impacts, since the project would be limited to areas already deeptilled and planted. Many opportunities to hunt and view wildlife would exist, but improvement would be limited. VQO's would be met. Fewer effects from reforestation would exist on visible slopes, causing less visual disturbance compared to Alternatives 1-3. However, this alternative

would result in a less desireable recreation setting in the future due to the absence of dense forest shading.

Alternative 5, the no action alternative, would result in extremely slow forest recovery. Hardwoods, brush, grass and forbs would dominate the scenery, with slow conifer reestablishment. VQO's would be met, since there would be no activity within the project area. Hunting and wildlife viewing opportunities would exist, but at reduced levels compared to the other alternatives.

None of the alternatives would effect the three undeveloped recreation sites in Indian Springs, Walton Cabin and Hunter Creek Crossing, consisting of roughly 5 acres each.

Alternative 1

Direct Effects

1. No significant adverse effects to recreational use would be caused by this alternative. The three undeveloped recreation sites (Hunter Crossing, Indian Springs and Walton Cabin) are not included in areas to be treated.

2. The following stands with a VQO of Retention would be treated:

   Cottonwood: 39, 43, 45, 46, 49. Note: Stands 43, 45, 46 and 49 have already been deeptilled and planted.

   Murphy: 8, 10, 51. A minimal portion of stands 48 and 49 would be treated.

   In these stands, conifer establishment activities would create dead plant material. The browning effect on unwanted vegetation would not meet the VQO for Retention. This short-term effect would last about 6-18 months.

Indirect Effects

Wildlife that are displaced by the treatment of competing vegetation may not be as visible as before treatments.

Cumulative Effects

In time, the establishment of conifers would add to the variety of the landscape and create a desirable, forested setting for recreational uses, including hunting, fishing and camping.

Alternative 2

Direct Effects

1. No significant adverse effects to recreational use would be caused by this alternative. The three undeveloped recreation sites (Hunter Crossing, Indian Springs and Walton Cabin) are not included in areas to be treated.

2. The following stands with a VQO of Retention would be treated:

   Cottonwood: 39, 43, 45, 46, 49. Note: Stands 43, 45, 46 and 49 have already been deeptilled and planted.

   Murphy: 8, 10, 51. A minimal portion of stands 48 and 49 would be treated.

In these stands, conifer establishment activities would create dead plant matter. The browning effect on unwanted vegetation would not meet the VQO for Retention. This short-term effect would last about 6-18 months.

Indirect Effects

The increased number of acres with higher oak levels may increase wildlife viewing opportunities.

Cumulative Effects

In the long term, this alternative would create a more attractive, shaded forest setting for recreation activities. In 20 years from project implementation, visual disturbances would recover and recreational opportunities for fishing, hunting and camping would improve.

Alternative 3

Direct Effects

1. No significant adverse effects to recreational use would be caused by this alternative. The three undeveloped recreation sites (Hunter Crossing, Indian Springs and Walton Cabin) are not included in areas to be treated.

2. The following stands with a VQO of Retention would be treated:

   Cottonwood: 39, 43, 45, 46, 49. Note: Stands 43, 45, 46 and 49 have already been deeptilled and planted.

   Murphy: 8, 10, 51. A minimal portion of stands 48 and 49 would be treated.

   In these stands, conifer establishment activities would create dead plant material. This browning effect on unwanted vegetation would not meet the VQO for Retention. This short-term effect would last 6-18 months.

3. About 671 fewer acres would be treated in this alternative, compared to Alternatives 1 and 2, resulting in a reduced total area affected by vegetation browning.

Indirect Effects

Like Alternative 2, the increased number of acres with higher oak levels may increase wildlife viewing opportunities. On the 671 acres that are not treated, the number of viewable wildlife opportunities may be reduced.

Cumulative Effects

In the long term, this alternative, like Alternative 2, would create a more attractive, shaded forest setting for recreation activities. The 671 acres that would not be reforested would remain dense brushfields with hardwoods for many decades. The areas that are like this can add variety to the landscape.

Alternative 4

Direct Effects

This alternative would create less extensive short-term impacts than Alternatives 1-3, since the project area would be limited to areas already deeptilled and planted.

Handgrubbing would occur in the following stands classified with a VQO of Retention: Cottonwood 43, 43, 46 and 49. These stands have already been deeptilled and planted.

Indirect Effects

Alternative 4 would offer similiar recreational opportunities to those that existed before the project. Vegetation changes that support recreational use would be very slow to materialize outside of the planted areas. The planted areas will begin to resemble forests within a decade, or so, offering forest-based recreation in a limited portion of the project area.

Cumulative Effects

This alternative would create limited long-term benefits to forest recreation and scenic values due to the absence of dense forest and shading.

Alternative 5

Direct Effects

There would be no direct adverse effects to recreation and scenic values with this no action alternative.

Indirect Effects

There would be no indirect adverse effects on recreation and scenic values from this alternative. Hunting and wildlife viewing opportunities would exist, but at reduced levels.

Cumulative Effects

No action would result in very slow forest recovery. Hardwoods, brush, grass and forbs would dominate the scenery, with slow conifer reestablishment.

Without the planting of conifers, much more time is required to achieve a forested condition through natural regeneration. The character of the landscape would remain open for several decades with an eventual dominance by oaks. A recreational setting characterized by a conifer dominated forest would be delayed.

More pressure would be placed on existing green islands from recreationists seeking shade.

H. Soil

The general effects of herbicides on soil:

This section analyzes the effects of the alternatives on managing surface and soil organic matter, soil porosity and soil cover for long term soil productivity. Studies show that herbicide application (Alts 1-3) at prescribed rates does not significantly affect soil microorganisms and water quality (R5-FEIS, "Effects of Herbicides on Soil").

While the effects of herbicides on soil organisms are quite variable, the three herbicides considered for use in this analysis (hexazinone, glysophate and triclopyr) would create very little or no change to most microorganisms, as discussed in the R5-FEIS. Hexazinone would create very little or no change in soil bacteria and algae, but would reduce some algae (R5-FEIS, Table 4-1, pp. 4-7).

Glyphosate and triclopyr tend to adsorb to soil particles and to organic matter and are resistant to leaching. Hexazinone, however, is more mobile within the soil profile, especially in soils with low organic matter and higher amounts of sand.

As noted in the R5-FEIS "the existing body of knowledge about the persistence and effects of herbicides in soil and water is incomplete because the soil environment is extremely complex. However, enough is known to make prudent judgements about the fate of certain herbicides in soil and water" (p. 4-10). The persistence and mobility of herbicides in soil in this project area overall are expected to be near the lower reported values because of subsoil clay content influence on soil permeability and the moisture regimes that occur in the project area.

Hexazinone is degraded in soil in 1 to 12 months depending on environmental conditions and microorganism activity. Triclopyr is degraded in soil in 3 to 6 months. Glyphosate is expected to be completely degraded in 3 months (VMFEIS, pp. 4-6 to 4-7; Ghassemi, et. al., December, 1981).

General Effects of Thermal Treatments:

Thermal treatments have the potential to directly effect soil cover as well as surface organic material, including large downed log levels. These have been considered in this analysis, as have indirect effects on soil erosion and soil organic material.

The following analysis addresses the primary issue of how each alternative would comparitively restore and maintain long-term soil productivity.

Alternative 1

Direct Impacts

1. This alternative would reduce soil cover on a total of 1,127 acres which would be broadcast burned before planting.

2. Bandarita-Mariposa soils have the highest potential for damage from burning due to low nutrients and organic matter. Soil cover, after broadcast burning, would meet the soil standards of the Forest Plan. (See Chapter 3, "Soils," for a list of stands with Bandarita-Mariposa.)

3. Soils identified as possessing very sandy soils or soils with low clay or organic matter have been excluded from hexazinone application (See Chapter 2, "Mitigation," BMP 5.9, for stand listing).

Indirect Impacts

1. This alternative would have a short term increase in erosion rate on those areas treated thermally with broadcast burns. This would be off-set by the reduced potential for larger, higher intensity wildfires and the associated high erosion rates.

2. Vegetation killed by herbicides on 11,750 acres would be available for microbial decomposition and incorporation into soil matter.

3. Alternative 1 would treat 758 acres with a 36 sqft/acre oak emphasis. This would increase long-term soil productivity by retaining oaks and oak litter.

Cumulative Impacts

1. Overall soil porosity would be improved. Soil cover and organic matter reduced on broadcast burned areas are short term and expected to recover rapidly and not impact long term soil productivity. Reduced hazardous fuel loading in the areas to be broadcast burned is expected to reduce the potential for future wildfires and its impacts on soil productivity.

Alternative 2

Direct Impacts

1. This alternative would reduce soil cover on a total of 1,127 acres which would be broadcast burned before planting.

2. Bandarita-Mariposa soils have the highest potential for damage from reforestation due to low nutrients and organic matter. Soil cover, after broadcast burning, would meet the soil standards of the LMP. (See Chapter 3, "Soils," for a list of stands with Bandarita-Mariposa.)

3. Soils identified as possessing very sandy soils or soils with low clay or organic matter have been excluded from hexazinone application (See Chapter 2, "Mitigation," BMP 5.9, for stand listing).

Indirect Impacts

1. This alternative would have a short term increase in erosion rate on those areas treated thermally with broadcast burns. This would be off-set by the reduced potential for larger, higher intensity wildfires and the associated high erosion rates.

2. A total of 2,467 acres would be treated with a 36 sqft/acre oaks emphasis. Another 863 acres would be treated with a 20 sqft/acre oaks emphasis. This serves to enhance longterm soil productivity by retaining more oaks and oak leaf litter than Alternative 1.

3. In Alternative 2, decaying vegetation on 11,750 acres proposed for treatment would be available for microbial decomposition and incorporation into soil matter.

Cumulative Impacts

1. Overall soil porosity would be improved. Soil cover and organic matter reduced on broadcast burned areas are short term and expected to recover rapidly and not impact long term soil productivity. Reduced hazardous fuel loading in the areas to be broadcast burned is expected to reduce the potential for future wildfires and its impacts on soil productivity.

Alternative 3

Direct Impacts

1. This alternative would reduce soil cover on a total of acres which would be broadcast burned before planting. This is 671 acres less than Alternatives 1 and 2.

2. Bandarita-Mariposa soils have the highest potential for damage from reforestation due to low nutrients and organic matter. Soil cover, after broadcast burning, would meet the soil standards of the LMP. (See Chapter 3, "Soils," for a list of stands with Bandarita-Mariposa.)

Indirect Impacts

1. This alternative would create a short term increase in the erosion rate on those areas treated with broadcast burns. This would be off-set by the reduced potential for larger, higher intensity wildfires and the associated high erosion rates.

2. This alternative prescribes 36 sqft/acre of oaks on 2,374 acres of treated stands. Another 807 would be treated with a 20 sqft/acre oaks. This would increase long-term soil productivity by retaining oaks and oak litter.

3. Vegetation controlled on 11,079 acres would be available for microbial decomposition and incorporation into soil matter.

Cumulative Impacts

1. Overall soil porosity would be improved. Soil cover and organic matter reduced on broadcast burned areas are short term and expected to recover rapidly and not impact long term soil productivity. Reduced hazardous fuel loading in the areas to be broadcast burned is expected to reduce the potential for future wildfires and its impacts on soil productivity.

Alternative 4

Direct Impacts

1. Manual release on 3,944 acres would not reduce ground cover to less than Forest Plan standards due to the management requirements for retention of ground cover, downed logs and minimizing soil displacement.

2. No acres within the project area would be burned for fuels reduction or site preparation.

Indirect Impacts

1. This alternative would have a short term increase in erosion rate on those areas treated thermally with broadcast burns. This would be off-set by the reduced potential for larger, higher intensity wildfires and the associated high erosion rates.

2. Large, continuous brushfields would create fire hazards, as described in Section C. Fire and Fuels. High intensity reburns would reduce soil productivity.

Cumulative Impacts

1. This alternative would maintain long term soil productivity. Soil porosity would be improved overall. Areas deferred from treatment would experience no change in key soil properties.

Alternative 5

Direct Impacts

1 Alternative 5, the no action alternative, would create no change in soil cover from current levels.

Indirect Impacts

1. Alternative 5, the no action alternative, would create no change in erosion hazard and soil organic matter levels from those currently existing on site.

2. Large, continuous brushfields would create fire hazards as described in Section C. Fire and Fuels. High intensity reburns would reduce soil productivity.

Cumulative Impacts

1. Alternative 5, the no action alternative, would not change any of the key soil properties ties to long term soil productivity.

I. Vegetation, Riparian and Sensitive Plants

This section discusses the consequences of each alternative on existing vegetation, plant diversity, sensitive plants, and riparian vegetation. The discussion responds to Issue 10 in Chapter 1.

Alternative 1:

Direct Effects:

This Alternative would reforest almost all capable, available and suitable land identified in the LMP. A total of 11,750 acres of conifer-hardwood forest would be reforested. Ten acres would not be reforested because of a combination of sandy soils, tall deerbrush, and steep slopes, which would prevent use of available tools such as hexazinone, ground applied glyphosate and triclopyr, or handgrubbing. At this time, 82 acres would not be reforested to provide for wildlife habitat needs. This alternative would reduce more competing vegetation and plant conifers on more acres than other Alternatives. No competing plant species would be completely eliminated from the stands (R5-FEIS, Page IV-20). Competing vegetation in most treated areas would be reduced to less than 20 percent cover for 2 to 3 years. Herbicides would not kill all of the targeted plants; the mature plants which have sprouted undisturbed since the fire six years ago are especially resistant.

Deeptilled and Planted Areas

The 3,780 acres currently deeptilled and planted would receive herbicide applications to reduce bearclover, other shrubs, and grass, and interplanting to replace dead conifer seedlings. Treated areas would have competing vegetation reduced to less than 20 percent of the area for the following 2 to 3 years. Interplanting would increase the number of Douglas fir, sugar pine, white fir, incense cedar, and giant sequoia, up to 30 percent of the stand, with the remainder being ponderosa pine. Species mixtures would be appropriate to the planting sites; low elevation sites would not have giant sequoia or white fir, and would have more ponderosa pine.

Scattered areas of natural seedlings, and plantations which survived the fire, would be treated at the same time as the surrounding unplanted areas. Sugar pine and incense cedar seedlings and saplings can be injured by hexazinone, so groups of sugar pine and cedar would be avoided where possible. Ground applications were proposed in cases where significant numbers of seedlings of these species needed to be protected. Almost all of the surviving seedlings are ponderosa pine and Douglas fir, which are resistant to hexazinone. Any lost or damaged tree could be replaced if needed, and green trees would continue to provide a natural seed source. Deeptilled areas which

would have ground application to maintain existing sugar pines and incense cedars are all in Walton Cabin in stands 21, 24, 62, 65, 66, 71, 73, 101, 102, and 103.

The LMP designates 246 acres in the proposed treatments as "key winter deer range"; these areas would be managed to retain oaks and forage. The stands designated as key winter deer range in the LMP would be managed to retain 20 percent cover of forage as required in LMP Standard and Guidelines 5-D and 5-J. Aerial applications would be modified to leave patches, and preferred forage species such as buckbrush would be left during ground applications in these areas.

Hardwoods would continue to be an important component of the area's vegetation. The stands described as key deer winter range in the LMP would have an emphasis on oak retention with a goal of maintaining 36 square feet of basal area of oaks, roughly equivalent to eventually covering 50 percent of the area. Oaks usually have a natural grouped distribution, and aerial applications would avoid oak groups by changing the treatment pattern. Increased oak cover would displace a proportionate amount of conifer cover. Other areas would retain large, mast-producing oaks because they are resistant to the proposed treatments. Pronone 10G (hexazinone) applications may kill up to 5-10 percent of the existing resprouting trees. An additional 40 percent may sustain light, temporary, damage. About 50 percent are not expected to exhibit any symptoms at all. Young oak seedlings would be killed by Pronone 10G in greater numbers because of their much smaller size. Ground application of a mixture of Accord and Garlon 4 (glyphosate and triclopyr) would not reach mature oaks because of their height; sprouting oaks and seedlings could be sprayed or avoided as needed. Only seedlings could be affected; sprouting oaks would only have their foliage affected, and would produce new leaves in the next growing season.

Unplanted Areas with Short Competing Vegetation

On these 7,299 acres of proposed reforestation, herbicide treatments would reduce competing vegetation to less than 20 percent of the area. Planting would reintroduce conifers, and the combination of planted acres with less vegetation, untreated areas, sprouting oaks, riparian areas, and patches of green oaks and conifers, would produce a complex mosaic of conifers and hardwoods. Untreated areas within treated stands would include:

> Any area with existing water at the time of treatment, such as rivers, streams, springs, and other riparian areas, and including the appropriate buffer areas.
>
> Cultural Resource sites.
>
> Tuolumne fawn lily population areas.
>
> Larger rocky areas and brushfields which are unsuitable for planting.

Areas with natural seedlings and surviving plantations would be treated at the same time as the surrounding areas as described above. Unplanted areas which would utilize ground application methods to maintain existing sugar pines and incense cedars are in Walton Cabin in stands 22, 100, 101, 102 and 103.

The Forest Plan designates 512 acres as key winter deer range and directs that levels of oaks and forage species be maintained as described above.

Some areas with short brush contain high fuels. Broadcast burning would occur is 456 acres to reduce fuels and improve access for planting.

Sprouting species such as alders, maples, azaleas, and dogwood would continue to recover in riparian areas. No treatments would be directed towards these species. These species primarily grow in and immediately next to streams, springs, and other water. Scattered individuals of all these species could project branches or sprouts beyond the 10 foot hand treatment buffer, and dogwoods may be found further from water, but no individuals would be found 100 feet from water. Therefore, aerial treatments would not affect these riparian species because of the 100 foot buffers required. Ground treatment buffers are much smaller. However, this would cause no effects to individuals of these species since they would be avoided during hand treatments.

Tuolumne fawn lily is found in several unplanted stands: Murphy Compartment stand 51, Bear Springs Compartment stands 111 and 112, and Paper Cabin Compartment stands 22, 23, and 38. Treatment of these stands would be modified as described in the Sensitive Plants section below.

Unplanted Areas with Tall Competing Vegetation

On the remaining 671 acres, treatments would be similar except broadcast burning or handcutting would occur to provide access for planting areas; these treatments would occur after treating the deerbrush with hexazinone. Dead and sprouting brush stems would be reduced by both methods, but not eliminated. Because these areas are generally north facing, the site would be optimal for planting a mixture of species including white fir. Tall deerbrush in Bear Springs Compartment stands 3, 31, 32, 38, 43, 64, 77, 78, 79, 80, 81, 84, 87, 88, 89, 90, 91, 92, 95, 101, 104, 105, 108, 120, 121, 122, and 138 would be broadcast burned; handcutting treatments would achieve the same results in Matsen Compartment stands 21, 33, 35, 36, 45, 47, and 49.

Tuolumne fawn lily is found in only one stand with tall brush: Stand 105 in the Bear Springs Compartment. Treatment of the stand would be modified as described in the Sensitive Plants section below.

Some of these stands are adjacent to riparian areas along Hunter Creek and its tributaries, but no direct effects would occur, as described above.

Other Burned Areas

Areas not suitable for reforestation would continue to recover. The 1987 fire left behind dead brush and hardwoods, which contribute to high fuels in this area. Broadcast burning would be used on 2,205 acres to reduce fuels. Vegetation in these areas would be partially burned; immediately after the burn there would be a mosaic of burned and unburned areas. Some sprouting hardwoods and brush could be killed, but most would survive. Fire suppression would be easier in these areas.

Sensitive Plants

Three of the thirteen known populations are in, or adjacent to, proposed treatment areas in stand 51 in Murphy Peak compartment, stands 105, 111, and 112 in Bear Springs compartment, and stands 22, 37, and 38 in Paper Cabin compartment. Hexazinone is active for up to two years of application, and Tuolumne fawn lilies would be killed if they came in contact with hexazinone. However, these aforementioned populations of Tuolumne fawn lily would be located flagged, and no herbicide treatment, including aerial treatments, would occur in a Tuolumne fawn lily area. Buffer zones similar to stream buffers would be used to protect the populations from aerial and ground applied herbicides. Prescribed burns would occur in one of these stands. Burning would occur in fall, well after the plants have withered for the season, as directed by current management guidelines. Also, the brush would be green and less flammable. No direct effect on Tuolumne fawn lily population would occur.

Green islands within stands would not be treated, so there would be no direct effects (Refer to Chapter 3, "Vegetation," for locations).

Indirect Effects:

Deeptilled and Planted Areas

Existing conifers would take advantage of the temporary shift in available soil moisture and respond with increased growth rates. Once conifers gained control by expanding their root systems, competing vegetation would reestablish at a lower rate. Natural seedlings could also take advantage of the available soil moisture to survive and grow, and any treated area within 100 feet of a mature conifer would have varying amounts of natural seedlings.

In some areas, competing vegetation would still grow fast enough that it would take up the majority of soil moisture and conifers would decline or die. In these areas, conifer seedlings would grow slowly, if at all, and mortality would be high unless additional treatments occurred. In addition, key winter deer range stands would have slower conifer growth and survival within the forage patches.

Competing plants would begin to reestablish themselves in the following winter and spring. Stored, or wind-dispersed, seeds would provide for colonization. Sprouting plants that survive the application, would regain full vigor in less than 5 years. Within five years after treatment, competing vegetation would cover 30 to 60 percent of the area (data taken from Fibreboard Corporation land). During reestablishment, brush would be younger and more vulnerable to any further control activities, if they are planned.

The reduction in grass and brush would reduce the habitat of conifer-damaging rodents and insects. Although gophers, rabbits, grasshoppers, and other damaging species would still exist, population levels would not be able to grow to epidemic proportions. Reduced moisture stress on the conifers would allow them to better survive insect and disease attacks.

Oaks affected by the herbicide would soon recover and be indistinguishable from the others. They would continue to grow and become well established in the developing forest.

Structural diversity would be increased in treated stands by the introduction of conifers. Planted conifers would provide vertical diversity more quickly than the process of natural reestablishment. Conifers would be available for snag recruitment as early as 40 years after stand establishment, if stands are maintained in good condition. Riparian areas would have a supply of large woody material in adjacent areas in a similar amount of time.

Unplanted Areas with Short Competing Vegetation

Results in these areas would be similar to the deeptilled areas, with the exception that seedlings would be planted after effective site preparation. Site preparation treatments would give newly planted trees an advantage over competing vegetation; the release treatments would maintain this advantage. Treatments similar to those proposed in this alternative were performed on private land, and resulted in 80 to 90 percent survival rates, numerous natural seedlings, and trees which are healthy and growing well (see Chart I-3, Survival within the Stanislaus Burn).

Shade-loving riparian plant species would eventually benefit from the shelter of the growing conifers wherever planted areas are contiguous to riparian areas. Within 40 years, young conifers would become large enough to provide suitable snag and down log materials for improving riparian habitat, as well as increase structural diversity.

Unplanted with Tall Competing Vegetation

These areas would have similar results to the short vegetation areas. Competing vegetation would be reduced, with the resulting increase in survival mentioned above.

Other Burned Areas

The 2,205 broadcast burn acres outside of the planting areas would continue to recover. Hardwoods and brush would resprout yet again. Grasses and forbs in the unburned area would easily reseed the burned areas. The reduced fuels would reduce the fire hazard on both the burned areas as well as the planted areas nearby.

Cumulative Effects:

Because of the reintroduction of a mixture of conifers, plant diversity would increase over the project area. Planted areas would be in a mosaic with other vegetation types. Riparian species would be allowed to recover where they exist. Hardwoods that survived the fire, combined with those that are resprouting, would form an integral part of the growing forest. Intermingled areas of untreated hardwood-shrub and hardwood-grass communities would increase diversity. Mature seral stages would return at a far greater rate than in Alternatives 4 or 5. Seral stages 3A and 3B/C would be reached within 20 to 25 years of planting, seral stages 4A and 4B/C would be reached within 35 to 45 years of planting. Seral stage 5 would be reached after 150 years, depending on the level of decadence in the stands.

Large contiguous areas of young stands would be present on both National Forest and private lands. Opportunities for diversity in seral stages would occur in the future. No increase in insect or rodent attack would occur, since insect and rodent habitat would be reduced.

Alternative 2:

Direct Effects:

This Alternative would reforest the same capable, available and suitable land as would Alternative 1. A total of 11,750 acres of conifer-hardwood forest would be restored. Ten acres would not be reforested because of a combination of sandy soils, tall deerbrush, and steep slopes, which would prevent use of available tools such as hexazinone, ground applied glyphosate and triclopyr, or handgrubbing. At this time, 82 acres would not be reforested to provide for wildlife habitat needs.

This alternative would relocate key deer winter range based on new telemetry data on deer use patterns (refer to Appendix 7). On 3,309 acres, there would be a goal to retain higher levels of oaks, which would substantially reduce the conifers growing in these areas. A total of 2,467 acres would have a goal of 36 square feet of basal area of oak, roughly equivalent to an eventual cover of 50 percent of the area. A total of 862 acres would have a goal of 20 square feet of basal area, roughly equivalent to an eventual cover of 30 percent of the area. As discussed in Alternative 1, greater retention of oak cover would decrease the amount of conifers. Because mature oaks are highly resistant to herbicides, especially hexazinone as discussed in Alternative 1, oak retention goals for wildlife needs would be easily met or exceeded. Deer forage would be retained in these areas as discussed in Alternative 1.

All other effects would be identical to those of Alternative 1.

Deeptilled and Planted Areas

Again, 3,780 acres would be in deeptilled areas. Results in these areas would be similar to those of Alternative 1, except 1,018 acres of the updated key deer winter range areas would be in this category. On 813 acres there would be a goal of maintaining 36 sq. ft. of oaks, and 205 acres would have a goal of maintaining 20 sq. ft. of oaks.

Unplanted with Short Competing Vegetation

This Alternative would treat 7,299 acres in unplanted areas with short competing vegetation. Results would be similar to Alternative 1 except 2,163 acres of this would be part of the updated key deer winter range. On 1,561 acres there would be a goal of maintaining 36 sq. ft. of oaks, and 602 acres would have a goal of maintaining 20 sq. ft. of oaks.

Unplanted with Tall Competing Vegetation

This Alternative would treat 671 acres in unplanted areas with short competing vegetation. Results would be similar to Alternative 1 except 148 acres of this would be part of

the updated key deer winter range. On 93 acres 36 sq. ft. of oaks would be retained, and 55 acres would retain 20 sq. ft. of oaks.

Indirect Effects:

This Alternative would be similar to Alternative 1 except for the greater number of acres with oak and forage retention goals. All treated areas would have similar vegetation responses as in Alternative 1. Treatments similar to those proposed in this alternative were performed on private land, and resulted in 80 to 90 percent survival rates (see Chart I-3, Survival within the Stanislaus Burn).

Cumulative Effects:

This Alternative would result in higher levels of landscape level diversity than described in Alternative 1. An additional increment of hardwoods would be maintained, resulting in reduced conifer levels in these areas.

Alternative 3:

Direct Effects:

This Alternative is similar to Alternative 2 except that no aerial treatment would occur. Results would only differ in the areas where reforestation is impossible without aerial treatment. The deeptilled areas and areas with short competing vegetation would be exactly the same as in Alternative 2.

Unplanted Areas with Tall Competing Vegetation

This Alternative would leave untreated these 671 acres of capable, available and suitable land because of tall vegetation which is untreatable with hand applied herbicides. Part or all of stands 21, 33, 35, 36, 45, 47, and 49 in Matsen Compartment, and of stands 3, 31, 32, 38, 43, 64, 77, 78, 79, 80, 81, 84, 87, 88, 89, 90, 91, 92, 95, 101, 104, 105, 108, 120, 121, 122, and 138 in Bear Springs Compartment would not be treated. Ground applications of herbicides are unfeasible on steep slopes where unwanted vegetation exceeds four feet. The height of the competing plants would require an elevated angle of application, creating an undesirable health risk to workers. The steep ground and thick brush makes walking hard at best; carrying heavy spray equipment through this vegetation would be hazardous. In addition, it would be almost impossible to cover enough of the leaf surface for glyphosate and triclopyr to be effective, and it would be equally difficult to apply enough hexazinone to be effective. Therefore, Alternative 3 eliminates all steep, unplanted areas with tall brush.

Some areas in key winter deer range have tall brush, and therefore would not be treated. A total of 148 acres listed as oak retention in the tall competing vegetation areas in Alternative 2, would not be treated at all.

The stands that would not be treated because of tall vegetation are primarily areas with deerbrush on generally north facing slopes. These are generally productive areas, suitable for mixed conifer and conifer-hardwood stands. The loss of productivity in these areas is not limited to wood products, but also includes wildlife habitat.

Sensitive Plants

This Alternative would be similar to Alternatives 1 and 2 except Stand 105 of Bear Springs Compartment would not be treated in the vicinity of the Tuolumne fawn lily population. Mitigation measures described above would not be necessary, since only 1 acre of deeptilled ground would be treated, which is not near the population.

Indirect Effects:

Indirect effects on treated would the same as those described for treated acres in Alternative 1. However, some of the stands dropped because of tall vegetation are adjacent to riparian areas. An estimated .9 linear miles of riparian area along Hunter Creek would not have any adjacent reforestation; recovery of shade and large woody material would be much slower in the absence of planted trees. An estimated 1.1 miles of riparian area along tributaries of Hunter Creek would have reforestation on only one side; this would reduce the shade benefits, but probably only slightly reduce the availability of large woody material compared to completely reforested areas.

Cumulative Effects:

Trends would be generally similiar to Alternative 2, except for the substantially lower recovery rate on the northfacing stands with tall brush, and the riparian areas mentioned above. Landscape diversity would be less than in Alternative 2 until these areas recovered, probably over 200 years in the future. Alternative 1 would still have less landscape diversity, with the exception of the riparian areas.

Alternative 4:

Direct Effects:

In this Alternative, 7,898 acres of the capable, available and suitable land would be left untreated. Only 3,944 acres would be treated, and no further planting would occur. Areas previously released by hand methods (2,163 acres) would be given one more hand release. Areas with no previous release treatment (1,781 acres) would be given two hand release treatments. No further hand release treatments could be recommmended because of the potential damage to tree roots. Repeated digging around the trees could remove vital topsoil from the lateral tree roots, and eventually grubbing could reach into the root zone and physically damage the tree.

Deeptilled and Planted Areas

The 3,780 acres of deeptilled areas would be maintained as conifer-hardwood. Hand grubbing would be far less effective at removing competing vegetation than herbicides. Treated areas would have larger amounts of vegetation remaining, as only the tops would be killed, and sprouting roots would remain.

No additional planting would occur beyond what has already been planted in deep till areas because of a lack of effective ways to control competing vegetation in the remaining acres, which have steep slopes with dense brush, grasses and forbs. Planting with no site preparation, with hand release treatment, has resulted in very poor

survival in the past. Only 32 percent survived the first year, and even with subsequent hand release treatments and interplanting, survival by the third year was down to 27 percent, and mortality is continuing to occur. See Chart I-3, Survival within the Stanislaus Burn.

Unplanted Areas with Short Competing Vegetation

164 acres of stands with natural seedlings would be handgrubbed. These stands would be handgrubbed because sufficient portions of them are stocked to make this treatment beneficial.

Unplanted Areas with Tall Competing Vegetation

None of these areas would be treated in this Alternative.

Indirect Effects:

The untreated areas would resemble hardwood and shrub communities for many decades. The poor control of competing vegetation in treated areas would result in a much higher rate of failure in the planted areas. Vegetation would return at a much faster rate than in Alternatives 1, 2, and 3. Handgrubbed areas have 80 to 100 percent cover of competing vegetation within 2 years after treatment. Initial survival would be much lower, 25 to 60 percent, in the existing planted areas (see Chart I-3, Survival within the Stanislaus Burn). Survival would continue to drop over time, until some areas become unstocked.

The existing plantings would become a mosaic of shrubs, hardwoods, and conifers, with shrubs and oaks predominating. Hand grubbing would increase moisture availability slightly, and survival of existing conifers would be an estimated 50 percent of existing conifers. The few surviving trees could become a source of seeds, which could slightly increase the rate of natural recovery. No burned riparian areas would have adjacent reforested areas; recovery of shade, snag, and large woody material would be much slower than in Alternative 1, 2, and 3, and only slightly better than Alternative 5. High amounts of competing vegetation would increase habitat for damaging insects and rodents, and reduce conifers resistance to attacks.

Cumulative Effects:

Only very slow invasion of conifers would occur, most likely taking over 150 years to make a visible shift toward a conifer-hardwood forest, and over 300 years to reforest the entire area. The large amount of land base in seral stage 1 would remain so for a long time. Of the small amount of land in seral stage 2 (planted), an estimated 40 percent would eventually grow into seral stages 3A and 3B/C. It is likely that the rest of the area would be understocked (seral stage 3A) or not stocked at all (seral stage 1). The present low diversity level may change slightly with the existing conifers.

Alternative 5:

Direct Effects:

In the absence of any additional action, the existing plantings would likely be overcome by competing shrubs and hardwoods on 70 percent of the area. Areas where conifers survived would have a large component of brush and oaks. Competing vegetation would continue grow without hindrance.

Indirect Effects:

Diversity would continue to be relatively low as conifer habitat would be highly restricted to portions of the existing plantings and to areas where adjacent living trees could provide for natural regeneration. As noted in Chapter 3, it would take at least 500 years for natural recovery to totally reforest the area in its former conifer and conifer-hardwood forests. Natural and common events such as wildfires could retard this process.

Cumulative Effects:

No area would have a change in seral stage due to this alternative. 70 percent of the area currently in seral stage 2 would return to seral stage 1. Diversity would remain at the current low level on National Forest lands in the project area.

The following chart compares the treatment emphases prescribed in Alternatives 1-4 by three types of vegetation areas: deeptilled and planted areas, unplanted areas with tall brush and unplanted areas with short brush. These areas are described in Chapter 3, Section I., Vegetation. The comparison illustrates the intention of Alternatives 2 and 3 to go beyond Alternative 1 objectives through the more accurate designation of key winter deer range areas. Also the comparison shows the difference between Alternatives 2 and 3 resulting from the lack of aerial treatments in Alternative 3. Alternative 4 shows no emphases since comparatively few acres would be treated, therefor oaks and forage would be in great abundance.

Table IV-2 - Acres of Emphasis by Area in Alternative 1

Area Acres	Emphasis Acres	Alt. 1 Acres	Alt. 2 Acres	Alt. 3	Alt.4
Deep Till	LMP	3,534	2,762	2,762	3,780
	Oak 20	0	205	205	0
	Oak 36	246	813	813	0
	TOTAL	3,780	3,780	3,780	3,780
Unplanted/Short	LMP	6,787	5,136	5,136	164
	Oak 20	0	602	602	0
	Oak 36	512	1,561	1,561	0
	TOTAL	7,299	7,299	7,299	164
Unplanted/Tall	LMP	671	523	0	0
	Oak 20	0	55	0	0
	Oak 36	0	93	0	0
	TOTAL	671	671	0	0

J. Water

The following analysis is divided into two sections to respond to Issues 11 and 12, described in Chapter I. Those issues are (1) the effects of herbicide use on water quality and (2) project effects on stream sedimentation.

The Effects of Herbicide Use on Water Resources

The following discussion describes possible levels of herbicide concentrations in surface water resulting from project implementation. Consequences to beneficial uses are described in the sections describing wildlife and health.

The environmental consequences from herbicide use are those expected to occur as of a result of project implementation using the Best Management Practices (BMPs) and other mitigations prescribed in Chapter II.

Alternatives 1-3:

Tables IV-3 and IV-4 on the following pages identify the treatment acres by watershed. The watershed map is in Chapter III.

Table IV-3 Treatment Acres by Watershed for Alternatives 1 and 2

Treatment	Year	Water-sheds 90101	90103	90501	90503	90504	90506	90601	90603	90604	90605
Release, Hexazinone Aerial	1994	78 (0.2%)	874 (19%)	717 (3%)	126 (12%)	62 (3%)	0 (0%)	49 (0.2%)	992 (10%)	329 (8%)	33 (0.3%)
Ground	1994	0 (0%)	0 (0%)	150 (1%)	27 (2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Site Prep, Hexazinone Aerial	1994	5 (0%)	655 (14%)	504 (2%)	50 (5%)	94 (4%)	0 (0%)	81 (0.3%)	1,226 (13%)	63 (0.3%)	13 (0%)
	1995	0 (0%)	0 (0%)	0 (0%)	0 (0%)	33 (1%)	0 (0%)	113 (1%)	1,207 (13%)	430 (10%)	211 (2%)
	1996	273 (1%)	1,097 (24%)	473 (2%)	0 (0%)	5 (0.2%)	73 (1%)	0 (0%)	791 (8%)	72 (2%)	91 (1%)
Ground	1994	0 (0%)	0 (0%)	113 (0.4%)	35 (3%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Release, Glyphosate/Triclopyr	1994	21 (0.1%)	30 (1%)	23 (0.1%)	42 (4%)	0 (0%)	0 (0%)	0 (0%)	160 (2%)	32 (1%)	35 (0.4%)
	1995	134 (0.4%)	1,575 (35%)	1,529 (6%)	280 (26%)	156 (7%)	0 (0%)	130 (1%)	2,398 (25%)	469 (11%)	81 (1%)
	1996	0 (0%)	0 (0%)	0 (0%)	0 (0%)	33 (1%)	0 (0%)	113 (1%)	1,248 (13%)	446 (10%)	211 (2%)
	1997	311 (1%)	1,104 (24%)	473 (2%)	0 (0%)	5 (0.2%)	73 (1%)	0 (0%)	818 (9%)	72 (2%)	91 (1%)
Site Prep, Glyphosate/Triclopyr	1994	30 (0.1%)	16 (0.3%)	22 (0.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	20 (0.2%)	45 (1%)	0 (0%)
	1995	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	41 (0.4%)	16 (0.3%)	0 (0%)
	1996	38 (0.1%)	7 (0.2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	27 (0.3%)	0 (0%)	0 (0%)
Interplant	1995	99 (0.3%)	904 (20%)	890 (4%)	195 (18%)	62 (3%)	0 (0%)	49 (0.2%)	1,183 (12%)	330 (85%)	68 (1%)

Treatment	Year	Water-sheds 90101	90103	90501	90503	90504	90506	90601	90603	90604	90605
Plant	1995	35 (0.1%)	671 (15%)	639 (3%)	85 (8%)	94 (4%)	0 (0%)	81 (2%)	1,246 (13%)	108 (2%)	13 (0.1%)
	1996	0 (0%)	0 (0%)	0 (0%)	0 (0%)	33 (1%)	0 (0%)	113 (1%)	1,248 (13%)	446 (10%)	211 (2%)
	1997	311 (1%)	1,104 (24%)	473 (2%)	0 (0%)	5 (0.2%)	73 (1%)	0 (0%)	818 (9%)	72 (2%)	91 (1%)
Broadcast Burn	1994	0 (0%)	0 (0%)	0 (0%)	0 (0%)	49 (2%)	0 (0%)	17 (0.1%)	812 (9%)	28 (1%)	0 (0%)
	1995	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	180 (2%)	11 (0.2%)	0 (0%)
	1996	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	30 (0.3%)	0 (0%)	0 (0%)

Table IV-4 Treatment Acres by Watershed for Alternative 3

Treatment	Year	Water-sheds 90101	90103	90501	90503	90504	90506	90601	90603	90604	90605
Release, Hexazinone Ground	1994	78 (0.2%)	873 (19%)	867 (4%)	195 (18%)	62 (3%)	0 (0%)	49 (0.2%)	992 (10%)	329 (8%)	33 (0.3%)
Site Prep, Hexazinone Ground	1994	44 (0.1%)	714 (16%)	686 (3%)	85 (8%)	45 (2%)	0 (0%)	64 (0.3%)	948 (10%)	35 (1%)	13 (0%)
	1995	0 (0%)	0 (0%)	0 (0%)	0 (0%)	33 (1%)	0 (0%)	113 (1%)	1,001 (10%)	419 (10%)	211 (2%)
	1996	234 (0.7%)	1,038 (23%)	404 (2%)	0 (0%)	5 (0.2%)	73 (1%)	0 (0%)	709 (7%)	72 (2%)	91 (1%)
Release, Glyphosate/Triclopyr	1994	21 (0.1%)	31 (1%)	23 (0.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	160 (2%)	32 (1%)	35 (0.4%)
	1995	211 (1%)	1,634 (36%)	1,598 (7%)	280 (26%)	107 (4%)	0 (0%)	113 (1%)	2,120 (22%)	441 (10%)	81 (1%)
	1996	0 (0%)	0 (0%)	0 (0%)	0 (0%)	33 (1%)	0 (0%)	0 (0%)	1,042 (11%)	435 (10%)	211 (2%)
	1997	234 (0.7%)	1,045 (23%)	404 (2%)	0 (0%)	5 (0.2%)	73 (1%)	0 (0%)	736 (8%)	72 (2%)	91 (1%)
Site Prep Glyphosate/Triclopyr	1994	68 (0.2%)	16 (0.3%)	22 (0.1%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	20 (0.2%)	45 (1%)	0 (0%)
	1995	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	41 (0.4%)	16 (0.3%)	0 (0%)
	1996	0 (0%)	7 (0.2%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)	27 (0.3%)	0 (0%)	0 (0%)
Interplant	1995	99 (0.3%)	904 (20%)	890 (4%)	195 (18%)	62 (3%)	0 (0%)	49 (0.2%)	1,183 (12%)	330 (85%)	68 (1%)

Treatment	Year	Water-sheds 90101	90103	90501	90503	90504	90506	90601	90603	90604	90605
Plant	1995	112 (0.3%)	730 (16%)	708 (3%)	85 (8%)	45 (2%)	0 (0%)	64 (0.3%)	968 (10%)	80 (2%)	13 (0.1%)
	1996	0 (0%)	0 (0%)	0 (0%)	0 (0%)	33 (1%)	0 (0%)	113 (1%)	1,042 (11%)	435 (10%)	211 (2%)
	1997	234 (0.7%)	1,045 (23%)	404 (2%)	0 (0%)	5 (0.2%)	73 (1%)	0 (0%)	736 (8%)	72 (2%)	91 (1%)

Direct Effects

The project is not expected to adversely affect beneficial uses because possible surface water concentrations are predicted to be below known thresholds of concern.

Accidental direct application and drift of herbicides are the most likely ways detectable amounts of herbicides could enter forest streams. The proposed use of the granular formulation of hexazinone (Pronone 10G) is expected to essentially remove drift through buffer zones. Aerial applications of hexazinone are proposed in Alternatives 1 and 2. Foliar-applied herbicides using ground application methods are proposed in in Alternatives 1-3. If an accidental application of herbicide occurs in a stream from ground spraying, the quantity of herbicide in water would be very low, last for only a few hours and would be undetectable by the time it was transported downstream. The use of the below listed BMPs are expected to minimize the risk of accidental discharge and adverse effects. these BMPs have proven to be effective in past projects and are expected to work in this particular project.

BMP 5.9 - Pesticide Application According to Label and EPA Registration Direction

BMP 5.10 - Pesticide Application Monitoring and Evaluation

BMP 5.11 - Pesticide Spill Contingency Planning

BMP 5.13 - Streamside and Wet Area Protection Zone During Pesticide Spraying

BMP 5.14 - Controlling Drift During Spray Application

Buffer zones will be established along all stream courses near herbicide treatment units, as follows: A 100 foot buffer for aerial hexazinone; 50 foot buffer for ground applied hexazinone; 10 foot buffer for glyphosate-triclopyr. Since aerial and ground treatments of hexazinone would take place in early spring, streams are expected to be flowing during applications of that chemical. Glyphosate and triclopyr would be applied in May.

Indirect Effects

Herbicides can enter surface water from sediment deposits, by leaching through the soil or in runoff waters collecting surface spray deposits from vegetation, ephemeral drainages, roads and landings.

Glyphosate and triclopyr:

Glyphosate (Accord) and triclopyr (Garlon 4), the foliar active herbicides planned for use in this project, are unlikely to contaminate surface or ground water within the project area, based upon research, cited in the R-5 FEIS for Vegetation Management for Reforestation (discussion on page IV-6 and Table 4-2 on page IV-8) and pre-1984 water quality monitoring data collected on this forest and filed here by the forest hydrologist, and water quality monitoring results from recent herbicide spray projects on the Groveland Ranger District and on the Eldorado National Forest. They have a short persist-

ence; since they are foliar-applied, they do not leach through soil. The small amount that does reach the soil would biodegrade. Only if a substantial rainstorm occurs immediately after application, would glyphosate or triclopyr be expected to reach water. Should such an event occur, herbicide concentration in water would be very low and would last for only a period of hours. Since leaching is not a property of these herbicides, they would not be expected to be detected in stream flows even in the long term.

Hexazonine: Hexazinone may be detectable in amounts as high as 2000 parts per billion (ppb) (or 2.0 ppm) in stream flow immediately below treatment units for Alternatives 1 and 2. This level of hexazinone would be of short duration and be the result of the first runoff producing storms after application. Hexazinone concentrations would decline rapidly downstream as a result of dilution caused by the addition of runoff from untreated areas. Hexazinone concentrations from storm runoff may be as high as 460 ppb in the lower reaches of Hunter Creek (refer to Chapter III, Paper EIS Watershed Map) and as high as 680 ppb in the lower reaches of Grapevine Creek as a result of proposed 1994 treatments. Other watersheds in the project area would have lower expected concentrations because of the much lower percentage of watershed area proposed for treatment.

For Alternative 3, which proposes ground based application, hexazinone may be detectable in amounts as high as 1400 ppb in streamflow immediately below treatment units. With downstream dilution, hexazinone concentrations would decline and may be as high as 280 ppb in the lower reaches of Hunter Creek and 520 ppb in the lower reaches of Grapevine Creek.

During periods of low streamflow, such as during late summer and early fall, hexazinone concentrations are expected to be much lower than the peaks expected to come as a result of storm flow. For Alternatives 1-3, concentrations as high as 40 ppb may occur immediately below treatment units. Again, downstream dilution would lower hexazinone levels to 10 ppb or less for Hunter Creek and 14 ppb or less for Grapevine Creek after proposed 1994 treatments. Other watersheds within the project area are expected to have lower levels during low flow periods.

Because treatment acres are lower for the years 1995 and 1996, it is expected that hexazinone levels as discussed above would be lower during these years. Detectable levels of hexazinone would likely remain in project area streams for 5 years.

Since hexazinone is soil-active, more mobile and persistent, and since it would be applied during the spring wet season, the potential is greater that hexazonine would enter surface and ground water than foliar-active herbicides glyphosate and triclopyr. With the use of treatment buffers and other BMPs described here and in Chapter II, hexazinone levels in project area streams are not expected to be biologically significant to aquatic life. The use of buffer strips, combined with the use procedures directed by the BMPs, is expected to place hexazinone in areas where the majority of it is absorbed into the competing plant's root systems and/or consumed by microorganisms, leaving very little available for offsite migration. The estimated herbicide residues are believed to be well below either acute or chronic levels for aquatic species and humans (R5-FEIS, pp. 4-50, 4-73 to 77, 4-90, 91). Hexazinone would be undetectable by the time it travels downstream to the Tuolumne and Clavey Rivers.

The following literature, modeling and monitoring provides the basis for expecting detectable quantities of hexazinone:

Literature Review: There are two pathways through which hexazinone enters surface streams, assuming there is no accidental direct stream application (Bouchard, et. al., 1985; Lavy, et. al., 1989; Mayack, et. al., 1982; Neary, et. al., 1983; Nutter, et. al., 1984). They are:

1. Direct storm runoff shortly after aerial application of Pronone 10G granules over ephemeral drainages which may be dry during the application, but are likely to sustain streamflow sometime later during the remainder of the winter precipitation period.

2. Leaching through soil moisture downslope until it surfaces at the nearest wet streamcourse. Research shows this results in hexazinone concentrations of about 400-500 ppb for short durations. Leachate into streams is usually much lower, from about 1 to 10 ppb, but can persist for a year or slightly longer.

Both runoff and leachate concentration are as measured just below the application area. Downstream dilution reduces the concentration. This is due to a fixed hexazinone amount mixed with increased water.

Although most hexazinone research is conducted in the eastern United States, site conditions such as soil texture and annual rainfall are similar to this project area. Soils in both areas include medium and finer textures. Rainfall is somewhat greater in the east but, as here, it results in runoff producing storms. This creates soil moisture which leaches downslope into streamcourses shortly after application.

Modeling: The Pesticide Root Zone Model (PRZM) is a computer program that predicts herbicide residues in water. It is used in cooperation among the Environmental Protection Agency (EPA), the Stanislaus National Forest, the Forest Service's Southeast Research Station and the University of Georgia (Dowd, Bush, 1990).

The PRZM predicted herbicide residues in water from an 88 acre site on the south slope of Smith Peak near Groveland. While this site is about 5 miles southeast of the project area, soil types, climate and vegetation are nearly identical. Results showed the following estimates from an April 1 aerial application of hexazinone (Pronone 10G) with an application rate of 1 kg a.i./hectare:

A concentration of 700 parts per billion (ppb) immediately below the treatment site in the first storms after application.

Non-storm flow concentrations as high as 10 ppb in the fall them gradually decline but persist above 1 ppb for about 1 year.

Downstream dilution since no other nearby application was simulated.

Note: For this project, application rates may be as much as four times the application rate used in the simulation. Project estimates were generated by multiplying the simulated predictions by the increased application rate. Because the model predictions have not been validated for local application, resolution or accuracy of estimates is not known.

Monitoring: There is no local hexazinone monitoring information available. Recent hexazinone monitoring on nearby national forests has limited applicability to this project because of significant differences in project size, buffer zones, timing of applications and ground conditions at the time of monitoring. The R5-FEIS (p. 4-8) states that between 1974-1984, twenty-nine water samples for hexazinone were collected in Region 5 and that only one had a detectable quantity (2 ppb).

No hexazinone monitoring data exist for private timber lands in Tuolumne County. Hexazinone is used on private timber lands on the North Coast of California although the monitoring record is not extensive (Greene, 1990s). The number of samples is unknown, but one project, in the spring of 1990, had a sample containing hexazinone (3 ppb).

Monitoring protocol is an extremely important factor in detecting herbicides in water, which explains the disparity between the results of hexazinone research projects such as discussed above. Private timber land operators are either not required to monitor or are often required to collect only one grab sample, usually in the first runoff producing storm after application (this procedure was also used on many past Forest Service projects).

Monitoring by a single grab sample can miss the presence of hexazinone in water. Research projects detect hexazinone in the water by sampling with greater frequency. Sample collection is also timed in relation to the stream hydrograph, both during storm events and later periods, since herbicides are known to pulse with streamflow and since hexazinone can persist in water for several months to more than one year. Monitoring in relation to stream hydrographs is planned for this project.

About 92 percent of the acres to be treated with herbicides would be treated with hexazinone. The remaining acres would be treated only with glyphosate and triclopyr. Each treatment site would receive more than one application of herbicide. For example, a broadcast application of hexazinone in one year would be followed by a year two directed spray application of glyphosate and triclopyr.

Cumulative Effects

The offsite effects of herbicide application on federal and private land have been considered. Herbicide application is part of private land reforestation efforts within the project area. It has also occurred on 895 acres of National Forest (Paper Cabin Release project) adjacent to the project area. The most recent applications have involved glyphosate and triclopyr in the early summer of 1993. Due to the rapid degradation of

these materials (less than 1 year), there is unlikely to be background herbicide levels in water when this project begins.

Background levels are not expected to add to cumulative effects as discussed below.

Hexazinone - There are five potential types of **hexazinone** cumulative effects:

Time-space relationships
Effects of bioconcentration and/or bioaccumulation
Synergistic effects of more than one herbicide in water
Indirect effects of herbicide application
"Nibbling" effects

Time-space relationship. The time-space relationship may be space-crowded, time-crowded or both time-and-space crowded (Neary, 1989). Space-crowded means applying herbicide to many parts of a watershed at the same time. Time-crowded means treating a portion of a watershed for an extended time period. Time-and-space crowding means both - treating much of a watershed for an extended period. For this project, time-and-space crowding effects are expected in the Hunter and Grapevine Creek watersheds since much of the herbicide application would occur there. Anticipated effects are as follows:

Applying hexazinone annually for 3 years is likely to produce detectable levels during those years, and perhaps for 1 to 2 years after application. "Detectable levels" refers to the ability to detect the molecule in a sample analyzed by a lab. The lab has the capability of detecting 2 ppb or greater. There is a high likelihood that hexazinone levels would not be as high as the levels predicted. There is, however, an expectation that low levels would be detected by our planned monitoring. Low levels are expected to dominate the monitoring period, with a higher peak that corresponds to the initial significant streamflow event. All existing water quality standards, including those of the State, are expected to be met. The presence of herbicides in streamflow, and its effects on the watersheds, were discussed in detail earlier within this analysis. In general, herbicide use is not expected to adversely affect beneficial uses of water. For effects on fisheries, refer to the "Wildlife" section within this chapter. For effects on human health, refer to the "Human Health" section within this chapter.

Annual pulses over 500 ppb may be detected in spring stormflows in the lower reaches of both Hunter Creek and Grapevine Creek if aerially applied over ephemeral streams. Low flows in summer could produce 1-15 ppb.

Microbial degradation would also reduce the amount of hexazinone in the soils and stream system. Once application is complete and any remaining residues are flushed from the stream systems of the project area, hexazinone will no longer be detectable.

Downstream from the project area, time-and-space crowding are not expected because of the high dilution rates encountered when project area streams reach either the Clavey or Tuolumne Rivers. Dilution in spring is expected to be hundreds to a thousand times in these streams (US Department of Interior, 1983). Once these flows reach Lake Don Pedro, hexazinone residues would be undetectable in this two million acre foot reservoir.

Bioconcentration/Bioaccumulation - No adverse cumulative effects are anticipated from potential bioaccumulation or bioconcentration of hexazinone in water (Ghassemi et al, 1981; USDA, 1984). Levels that are expected to occur are expected to occur as low levels for the majority of the time period, with limited pulses at higher levels corresponding to initial, streamflow-producing storms. This type of exposure fails to support bioaccumulation. Organisms tested to date, lower concentration levels in response to the external environment's concentration level. Bioaccumulation is the build-up of residue in a receptor, such as a fish or a human, from repeated exposures coupled with the body's inability to metabolize it. Bioconcentration occurs when there is an accumulation of residues during high pollutant concentrations in water. When the concentration decreases, the pollutant level in the receptor also decreases.

Synergistic effects - Synergistic effects of hexazinone with the other herbicides proposed for this project are not anticipated in project area waters. These chemical combinations are not believed to produce mixing effects deleterious to humans (R5-FEIS, p 4-112).

Indirect effects - Indirect effects of hexazinone application are those which produce water quality impacts not directly related to the effect of the herbicide itself. It is expected that where herbicides are applied, stream sedimentation would be reduced compared to areas that are thermally treated. This positive indirect effect of herbicide use occurs because the living plants killed by herbicides remain on site as mulch rather than being physically removed by other methods.

Another possible indirect effect of herbicide application is that nitrogen discharge may increase as vegetation is killed by herbicides, thus decreasing plant uptake of this nutrient. It is expected that such increase, however, would not exceed water quality standards (Neary, 1989).

Nibbling. "Nibbling" effects are the additive contributions of pesticides to water. While a single pesticide may be insignificant, the sum of many different pesticides may be deleterious. Such an effect is usually limited to situations where many persistent pesticides are used in a watershed. This is not expected to occur since the herbicides planned for use do not persist long enough for such impacts to occur.

Glyphosate and Triclopyr are foliar-active chemicals. They have short half-lives and very low potential to enter water. Time or space crowding effects are not expected in water either within the project area or downstream. If an accidental overspray or spill occurs, the herbicide residue is dispelled from the watersheds within hours or days.

Neither glyphosate or triclopyr are known to produce bioaccumulative or bioconcentrative effects on aquatic species or humans. Synergistic effects are not anticipated to result from any combination of glyphosate, triclopyr or hexazinone (R5-FEIS, p. 4-112) in any of the project area's water.

Indirect and nibbling effects are essentially the same as for hexazinone.

Alternatives 4 and 5:

There are no herbicides proposed for Alternatives 4 and 5, consequently there would be no significant adverse direct, indirect or cumulative effects on water quality due to herbicide use.

Sedimentation

The following analysis examines the effects of the alternatives on stream sedimentation. The environmental consequences described are those that are expected to occur as a result of project implementation using the Best Management Practices/mitigations prescribed in Chapter II.

Alternatives 1, 2, 3 and 4:

Direct Effects

The potential for direct effects on water resource values such as stream water quality, Streamside Management Zones (SMZ's) and riparian areas would be minimal with implementation of any of the action alternatives. Direct effects include, direct entry of sediment to channels, damage to streambanks and damage or removal of vegetation within SMZ's that would reduce their unique resource values. Proposed treatments do not include the use of mechanical treatments. Fuel or site-prep burning would be conducted such that riparian areas are protected. They are managed to maintain or improve values for fish, wildlife, water quality, or other downstream beneficial uses of water.

Riparian areas would be improved in Hunter Creek and Grapevine Creek through implementation of any of the action alternatives 1-4, as a result of planting conifers.

Indirect Effects

All action alternatives have the potential to cause minor increased delivery of sediment to streams within the project area. Sedimentation, an indirect effect, results from winter rainfall on areas that have been burned or have been disturbed by hand release treatments. In Alternative 4, hand grubbing and scalping around seedlings creates a small bare spot and although several hundred such spots are created per acre, each is surrounded by existing ground cover.

Soil which may be subsequently detached by rainfall from the bare spots is likely to be transported only a few feet to the nearest location of ground cover and then re-deposited. R-5 Soil Quality Standards (refer to LMP, pp. IV-75, 76) and water quality Best Management Practices are applied during thermal fuel reduction or site-prep treatments. This retains ground cover to sufficiently minimize erosion and establishes streamside management zones to buffer against sediment delivery to streams. Compared to erosion and sedimentation from storms shortly after the 1987 fire, reforestation practices should have a negligible additional impact on streams in the project area. Stream channels now recovering following the fire should not be materially degraded again once reforestation occurs.

Selection of Alternative 5, the No Action Alternative, would result in no land disturbing activities and therefore no sedimentation would occur in stream channels nor Streamside Management Zones. With Alternative 5, riparian areas would not be replanted with conifers and natural recovery of these areas would take place slowly.

Cumulative Effects

The off-site effects of sedimentation from private and federal land have been considered. Erosion and sedimentation from post-fire and salvage logging on both federal and private inholdings have substantially decreased. Ground cover recovery has been very good as a result of seeding and native plant regrowth. Few barren, degraded areas remain. The following cumulative effects discussion includes impacts from all lands within the project area.

The post-fire sediment now in transit in streams such as Hunter, Grapevine and Duckwall Creeks would continue moving downstream in annual winter pulses until flushed from the stream system and deposited in Don Pedro Reservoir.

Reforestation efforts may further contribute to off-site sedimentation, but based upon field investigations and calculations of equivalent roaded acres (ERA's) after six years of watershed recovery, future estimated sedimentation effects should be insignificant. ERA's are a a method of estimating cumulative watershed effects (see FSH 2509.22). The greatest watershed of concern is the upper Hunter Creek watershed, which was one of the most intensely burned areas. The ERA's for that watershed are 5.93 percent. The threshold of concern for all watersheds is 12 percent. No other project area watershed has a higher ERA.

Sedimentation would be reduced where herbicides are used instead of thermal treatments. In areas where herbicide alone is used to control unwanted plants, those plants remain on site as ground cover. Ground disturbance is also less compared to areas where thermal activities occur.

Any increased sedimentation resulting from reforestation should have negligible adverse cumulative watershed effects. This would change only if there is a large scale increase in mechanical or thermal treatments if reforestation is delayed. In that case, dense brush may have to be treated with machinery or fire prior to or in lieu of herbicides. The magnitude of such an effect is not known at this time.

K. Wildlife/Fisheries

Reforestation activities would have direct and indirect effects on wildlife and fish populations from herbicide use, broadcast burning and manual methods. These effects vary depending on the alternatives. The majority of potential effects on wildlife species would occur indirectly through changes in habitat from these methods.

Refer to the R5-FEIS Chapter 4, pp 41-55, for general wildlife and fisheries impacts from reforestation activities, the biological assessment for effects of this project on Federally listed Threatened and Endangered species, dated September 3, 1993, and the Biological Evaluation for effects on Forest Service Sensitive species, dated August 13, 1993 (see Appendix 4).

Mitigation measures designed to protect wildlife and their habitat are presented in Chapter 2, "Wildlife," and R5-FEIS, Chapter 2, table 2-7.

In Alternatives 1, 2 and 3, the project would reforest roughly 50 percent of the burn area. Most of the excluded areas consist of steep river canyon slopes. A significant difference between the alternatives

is the number of acres managed for oaks, which would affect wildlife and habitat. Each alternative, depending on the number of acres of oaks, provides a different population capability for:

Early seral forest wildlife species, such as deer, quail and western gray squirrel

Cavity-nesting birds and late seral forest species. SOHA M16 and PAC TL146 will provide for the spotted owl in all alternatives.

Fishery habitat.

In Alternatives 1, 2 and 3, conifers would be planted in the Streamside Management Zone (SMZ) while hardwoods re-establish themselves naturally. The combination would accelerate recovery of the riparian zone. Alternatives 1 and 2 would reforest .9 miles more SMZ than would Alternative 3. Alternative 4 would reforest considerably less acreage along riparian edges. Alternative 5 proposes no reforestation. Alternatives 4 and 5 would provide considerably more natural recovery along the streams, resulting in a brush dominated riparian zone that retards full recovery of shade-producing trees. This decreased shading effect is expected to produce higher water temperatures. Some riparian deciduous trees would return naturally along portions of the streams, yet recovery of the stream habitats to full capability probably would not occur for 50-75 years. Differences related to riparian plant recovery are minor, as no alternative directly affects them. Conifer reestablishment within the riparian zone would be equal in Alternatives 1 and 2, with Alternative 3 slightly lower as reforestation of steep slopes with tall brush would not occur. Alternatives 4 and 5 do not reestablish conifers within riparian areas.

Alternatives 1, 2 and 3 would have similar effects on fisheries. These alternatives foster rapid recovery of the riparian habitat by providing cover, which would protect fish from predators, and by providing stream shading, which would create cooler water temperatures. Conifer and deciduous trees in the riparian zone would begin to meet these habitat needs in 15-20 years. Fish populations would recover the most quickly under Alternative 2, with Alternative 3 recovering less quickly due to less reforestation along SMZ's. The replacement of large woody material is related to the extent of conifer reestablish, as described above. This is an important aspect for recovery of the fisheries habitat.

No direct effects from herbicide use are expected on fauna that inhabit the area. Use levels are lower than any known acute toxicity level for local fauna. The only possible effect identified is on amphibians from hexazinone. California red-legged frog and western pond turtle are both Region 5 Sensitive species and the foothill yellow-legged frog is a species of concern, all of which occurred before the fire and probably still occur (refer to the Biological Evaluation in Appendix 4. Of the three herbicides proposed in Alternatives 1, 2 and 3, hexazinone poses the highest likelihood of entering streamwater during spring rainy periods. High concentrations could adversely affect amphibian species, specifically the California red-legged frog. According to the Biological Evaluation, this species' sensitivity to the herbicides being applied is uncertain. The populations of this species have been severely reduced and this project, if the predicted levels are capable of causing adverse effects, may continue the trend toward Federal listing. Alternatives 1 and 2 would treat 6,276 acres with hexazinone in year 1994, while Alternative 3 would treat 6,112 acres.

Restoration of oak habitat benefits the habitat capability for mule deer, western gray squirrel and mountain quail. Conifers contribute to the recovery of habitat for cavity nesting birds, such as the white-headed woodpecker, pileated woodpecker, goshawk and spotted owl which depend on conifer crowns. The Forest standard for oak retention is 10 square feet per acre everywhere higher levels are not specified.

Alternative 1 would provide 758 acres at 36 square feet per acre within treated stands. Alternative 2 would provide for 862 acres and 2,467 acres at 20 and 36 square feet per acre of oaks, respectively. Alternative 3 would provide for 807 and 2,374 acres at 20 and 36 square feet per acre of oaks, respectively. The subsequent recovery and quality of oak and dependent species would be greatest under Alternative 5, followed by 4, 3, 2 and 1 in that order.

Alternative 1

The benefits to the white-headed and pileated woodpeckers are greatest under this alternative and Alternative 2 once the tree size needed by these species is reached (40 and 75 years, respectively). This alternative and Alternative 2 would also create the most beneficial future habitat for goshawk and spotted owl. It would be the least beneficial for deer, gray squirrel, and mountain quail. For this alternative, potential, as described in Appendix 4, exists to affect amphibian species.

Direct Effects

Direct effects are defined as toxic or physical effects on growth, health, behavior, reproduction or physical injury or death (R5-FEIS).

1. Herbicides - direct contact

a. This alternative poses a low risk of direct mortality to terrestrial species from herbicide exposure. In most cases, the bird and mammal doses are 50 to 100 times lower than the LD_{50} level for the most closely related test species and for rainbow trout, and for hexazinone, over 200 times lower.

Under worst case circumstances where an individual animal is directly sprayed and consumes only contaminated diet items, there would be a risk of fatality or severe effects from the herbicides, but this is highly unlikely.

b. Alternative 1 calls for aerial and ground herbicide application of 6,752 acres in the first year. Of this, 93 percent would be treated with hexazinone. In the second year 8,803 acres would be treated. Of that amount, 77 percent would be treated with glyphosate and triclopyr. With regard for direct effects to wildlife, in general, the analysis in the R-5 FEIS found that wildlife was not at risk from realistic herbicide doses. When doses exceed 1/5 of the LD_{50} the criterion EPA recommends for assessing risk, the animals are considered at risk of fatality or lesser toxic effects. Doses lower than 1/5 of the LD_{50} are assumed to pose low risk. Dosages for typical application rates of the three proposed herbicides are presented in Table IV-5 on the following page.

Table IV-5: Expected Herbicide Exposure Rates to Terrestrial Species For Typical Application Rates (R5 FEIS).

Herbicide and application rate	Animals	Dose to Animal (potential)	LD_{50} of animal
Glyphosate @ 3.0 lbs/acre	Quail Rabbit Deer	2.7 mg/kg 12.6 mg/kg 5.4 mg/kg	2,000 mg/kg 3,000 mg/kg 320 mg/kg
Triclopyr @ 1.5 lbs/acre	Quail Rabbit Deer	2.4 mg/kg 6.8 mg/kg 7.2 mg/kg	1,698 mg/kg 550 mg/kg 471 mg/kg
Hexazinone @ 4.0 lbs/acre	Quail Rabbit Deer	1.4 mg/kg 9.5 mg/kg 4.0 mg/kg	2,000 mg/kg 860 mg/kg 1,690 mg/kg

All of the above expected dosages to the wildlife species mentioned are well below 1/5 of the LD_{50} and are therefore assumed to pose a low risk. Since the maximum proposed application rates are 1.5 lbs/acre for glyphosate, 1.0 lbs./acre for tryclopyr, and 3.5 lbs/acre for hexazinone, the actual dosages would be expected to be even lower.

c. The toxicity levels of tryclopyr and hexazinone are unknown for reptile and amphibian species. Amphibian and turtle species are potentially susceptible to toxic effects of herbicides from both terrestrial and aquatic exposures. The risk of exposure from direct chemical application is very low since treatment buffer zones would be adhered to for intermittent streams and their riparian zones.

2. Herbicide - runoff

a. Direct effects on aquatic species are related to the concentration of herbicide which finds its way into the water. Table IV-6 provides estimates of herbicide concentrations for normal use rates and acute toxicity for certain aquatic species (R5 FEIS p. 4-50,51).

TABLE IV-6: Acute Toxicity Data for Aquatic Species and Potential Concentration (R5-FEIS)

Herbicide	Species	Concentration* (ppm)	LC_{50} (ppm)
Glyphosate	Bluegill Rainbow Trout *Daphnia*	.028	.8-4.2 1.3 3.0
Triclopyr	Bluegill Rainbow Trout *Daphnia*	.040	.87 .74 --
Hexazinone	Bluegill Rainbow Trout *Daphnia*	2.0	370-420 180 152

According to the EPA criteria, if the ratio (Q value) of the estimated environmental concentration (EEC) to the LC_{50} is less than 0.1, there is no acute toxicity. If the Q value is between 0.1 and 0.5, there is a risk of acute effects that may be mitigated. If the Q value is 0.5 or greater, the risk of acute effects is significant. Neither bluegill or *Daphnia* (a crustacean) occur in the project area, but are shown for comparison to rainbow trout, the primary trout species in the area. The highest Q values for these species would be .054 for trout from triclopyr and .004 for *Daphnia* from hexazinone. A Regional "worst case" concentration value of .097 results in a Q value of 0.13 for trout from triclopyr (R5 FEIS).

Testing of these chemicals has not been done for western pond turtle, but some tests with hexazinone on frog (genus Rana) tadpoles have been done in Eastern Canada (Berrill, 1993). Because amphibians respire through their skin, they may be more susceptible to environmental toxins than fish, mammals or birds (Hartwell Welsh, pers. comm., 1993).

Using Regional estimates of triclopyr water concentrations (R5-FEIS, 4-50), it is quite possible acute toxicity to some amphibians would occur. However, Stanislaus NF hydrology specialists estimate that stream buffers from treated areas would prevent both glyphosate and triclopyr from entering stream waters.

It is anticipated that hexazinone stream concentration during peak runoff periods could be 2.0 ppm or higher. In order to reach a Q value of 0.1 for amphibians their LC_{50} for this herbicide would have to be 20 ppm, a threshold of effect 6.0 times lower than rainbow trout. Work by Berrill (1993) showed that ranid tadpoles showed no adverse effects at concentrations of hexazinone up to 100 ppm, or 50 times in excess of the levels predicted.

For other species there is very little chance of any direct mortality from herbicide exposures from this alternative using hexazinone, triclopyr and glyphosate. As stated, in most cases, the bird and mammal doses are 50-100 times lower than the laboratory lethal level for the most closely related test species and for rainbow trout (from Hexazinone) over 200 time lower. Under worst case circumstances where an individual animal is directly sprayed and consumes only contaminated diet items, there would be a risk of fatality or severe effects from the herbicides, but this is highly unlikely. Only under extremely rare circumstances would an animal be likely to be seriously affected in a spraying operation.

The Biological Evaluation (Appendix 4) for this project found that use of chemicals might, in some cases, affect individuals but that there would be no trend toward Federal listing as a result (Rickman, 1993).

3. Broadcast burning: Broadcast burning poses the greatest potential for causing direct effects. In general, an animal's susceptibility depends on its mobility and ability to seek shelter. Deaths and injuries attributed to fire have been documented for various wildlife species, but the impact on populations is generally negligible (R5-FEIS, p. 4-42).

   Over the span of four years from the date of implementation, a total 2,205 acres would be broadcast burned to reduce fuels and fire risks. A total 456 acres would be broadcast burned for site preparation (refer to Chapter 2, "Fire/fuels").

Indirect Effects

The initial impact of most treatments is a short-term reduction in the total amount of forage and cover (R5-FEIS, p. 4-45). The long-term effect would be a mosaic of habitats created through a combination of reforestation prescriptions and areas not treated. Refer to Table IV-7 for a comparison of the effects of the alternatives on potential habitat capability on selected indicator species.

This alternative, like 2 and 3, emphasizes rapid recovery of the SMZ by providing cover for fish and stream shading for temperature cooling. Conifer and deciduous trees in the riparian zone would begin to meet these criteria in 15-20 years, but alternative 2 would have slightly better riparian recovery because of increasing amounts of hardwoods intentionally managed outside the SMZ (50-100 foot width). Alternative 3 would have slightly better recovery near reforested areas because of this increase in hardwoods, but would have lesser recovery rates overall because 0.9 miles of SMZ along Hunter Creek would not be reforested. Fish populations would recover most quickly under Alternatives 1, 2 and 3, compared to 4 and 5.

1. Herbicides: Use of aerially applied herbicides limits where snags and mast-producing hardwoods can be left (refer to Chapter II, Tables, II-2, II-4, and II-7 and Emphasis Maps for Alternatives 1-3 for comparison of acres treated by emphasis). The effects on wildlife capability are described below and in Table IV-7 for other indicator species.

2. Conifer/Hardwood Management: Alternative 1 calls for 36 square feet of basal area per acre (sqft/ac) of oak on 758 acres. This would lead to medium-high oak habitat quality on 3,444 acres for gray squirrel and 1,100 acres of high quality habitat for mountain quail.

   a. Within 30 years planted stands would provide thermal cover for deer and the eventual cover:forage ratio of 93:7. This would be lower in forage than the ideal for winter range and would represent capability for less than 1,000 deer during the winter.

   b. Habitat for 3 pair of goshawk and six pair of spotted owls in 100 years.

   c. Best alternative for restoring capability of white-headed and pileated woodpeckers in 40 to 75 years, respectively.

3. Broadcast burning: This method generally causes an initial reduction in food and cover, but this effect is soon eliminated by new sprouts or new seedlings that are the result of stimulated seed germination. Initially, risk of damage to habitat from fire includes eliminated snags, logs, brush piles and hardwoods used for wildlife habitat. Fire has the added risk of escaping and causing damage to special habitats and areas not intended for burning.

Cumulative Effects

Cumulative effects involve this project and other past and future projects in the same geographic area. The suitable wildlife geographic area includes all of the Mi-Wok Ranger District and the northern portions of the Groveland Ranger District north of the Tuolumne River. This area is about 252,000 acres and is all national forest between the Middle Fork Stanislaus and Main Tuolumne River below 5,500 feet elevation. It includes all the winter range for the Tuolumne River Deer Herd, and the southern winter range for the Stanislaus River Deer Herd.

Wildfire, burn reforestation, and green timber sales have affected the habitat condition in recent times. Timber sales will continue into the future as will unplanned wildfires. Large wildfires that have occurred in this area include:

Wrights Creek Burn of 1950 and the Flora Burn of 1960: total 17,600 acres

Granite burn of 1973: total 17,000 acres (includes about 5,000 acres of private forest lands)

Cotton Burn of 1489: 2,550 acres

Both the Wrights Creek and Flora Burns were located immediately upslope from the project area in the North Fork Tuolumne River drainage. Reforestation occurred in these burns during the 1950s and 1960s. Many wildlife species use this area in common with the project area; this includes mule deer that migrate through these old burns into lower elevation winter range in the 1987 Paper Fire area. Reforestation in the Wright's Creek and Flora Burns provided almost no retention of native oaks or brush, which created a drastic reduction of within-stand diversity.

The Granite burn area is in the Cherry Creek and Jawbone Creek drainages east of the Clavey River. The eastern sub-herd of the Tuolumne Deer Herd uses this area. Granite Burn Reforestation took place during the middle and late 1970s, when more native oaks and brush were retained than in the other burns due to identification of deer delay areas and the restrictions on herbicide use.

Much of the Paper Fire project area has been harvested within the past 140 years. About half the unburned areas are commercial timber producing lands. Reforestation practices in the past 20 years retained little oak and brush. This resulted in reduced native oaks and brush in some areas. Present practices retain more oaks, at 10 or 36 square feet per acre, depending on the wildlife emphasis. Future oak retention may be even higher as more is learned regarding natural diversity.

Early and middle successional stages resulted from management practices and wildfires on most of the 252,000 acres. There are still large (mostly second growth trees), dense, timber stands providing for species such as spotted owl. This habitat is highly fragmented, and successful reforestation would result in favorable habitat in 50 to 100 years. Reforestation in the older burns did little to enhance early seral forest species, resulting in diminished early seral stage habitat capability.

The long-term cumulative effects, including effects from past and anticipated future projects are:

1. Reduction of native oaks and shrubs compared to natural untreated conditions. Oak and browse retention would be higher than required in the past. This project would not be as detrimental to oaks and browse compared to burn reforestation prior to 1970. Cumulative effects from habitat reduction are minimal because brush and grass are expected to be reduced for only a short period of time, and are expected to become re-established from sprouting or seed germination after a few years.

2. Provision for future old growth in the fastest possible timeframe. Decisions about stand management for late seral forest wildlife versus timber production can be made later. The important consideration is reestablishing some stands so the potential is available.

3. Cumulative chemical effects on animal populations are expected to be negligible due to herbicides breaking down and animal movements in and out of treated areas.

Alternative 2

Alternative 2 has more acres of stands that are managed for oaks than Alternative 1. This alternative designates 2,571 more acres of stands with higher levels of oaks (20 and 36 sqft/ac) retained to improve wildlife capability. Among the five alternatives, Alternative 2 ranks highest with Alternative 1 in benefits to snag-dependent species, goshawk and spotted owl. It ranks fourth for gray squirrel and is approximately equal to Alternative 3 and 4 with regard to mule deer habitat capability. Alternatives 1 and 2 have the highest potential impact to sensitive amphibian species due to the use of aerial application methods.

Direct Effects

Direct effects are defined as toxic effects on growth, health, behavior or reproduction, physical injury or death (R5-FEIS).

1. Herbicides: Same as Alternative 1.

2. Broadcast burning: Same as Alternative 1.

Indirect Effects

This alternative would have a similar long-term effect on recovery of the riparian habitat as Alternative 1. Fish populations would recover at a rate similar to Alternative 1. Refer to Table IV-7 for a comparison of indirect effects on indicator species for all alternatives.

1. Herbicides: Same effects as Alternative 1. However, herbicide treatments on 2,571 more acres would be tailored to meet higher oak stocking for wildlife habitat by selective spraying with hand crews and aerial application. The effects on wildlife capability are shown below and in Table IV-7 for other indicator species.

2. Oak and Conifer Management: Retain 36 sqft/acre of oak on 2,467 acres of winter deer range in areas of concentrated use. Retain 862 acres of winter deer range in migratory corridors. This would foster low to medium-high oak habitat quality on 7,716 acres for gray squirrel and 3,930 acres of high quality habitat for mountain quail.

   a. Provide deer cover: Forage ratio of 63:37 in 30 years when cover is reestablished. This would provide winter range capability for 2,000 mule deer.

   b. Provide habitat capability for 2 pair of goshawk and 6 pair of spotted owls in 100 years.

   c. This alternative, like alternative 3, would be second to Alternative 1 for habitat needs for woodpeckers in 40 to 75 years.

3. Broadcast Burning: Same as Alternative 1.

Cumulative Effects

1. This alternative and Alternative 3 rank highest for mitigating the decreased biodiversity in older burn reforestation projects, by retaining greater amounts of shrubs in reforested stands.

2. Wildlife biodiversity may be affected positively by herbicide applications over the project area since treatment units would more rapidly return to mature forest stands.

3. Other cumulative effects would be the same as Alternative 1.

Alternative 3

Activities in this alternative pose less potential harm to aquatic species, from potential herbicide levels in streamflow, than Alternatives 1 and 2. Of the five alternatives, Alternative 3 would be less beneficial for snag dependent species compared to Alternatives 1 and 2. It would not provide as rapid a recovery for late seral forest species such as goshawk and spotted owl compared to Alternatives 1 and 2. It would rank second, next to Alternative 4, for mule deer. The two differences between this alternative and Alternatives 1 and 2 are that less acres are treated with herbicides and that all treatments would be ground applications. The 671 acres of steep slopes with dense, tall brush, which are not treated in this alternative, would result in dense brushfields with scattered hardwoods.

Direct Effects

1. Herbicides: Effects are similiar to Alternatives 1 and 2, but on fewer acres. The 671 acres of dense, tall brush would not be altered by this alternative. Alternative 3 proposes treating 11,079 by non-aerial methods. If amphibians are sensitive to the predicted levels of hexazinone, this would reduce the potential risk to Sensitive amphibians as described under Alternative 1 and 2, since there would be no application to ephemeral streams and lower levels would be available to travel to perennial streams.

2. Broadcast burning: A total of 456 acres would be broadcast burned, which is 671 acres less than Alternatives 1 and 2.

Indirect Effects

This alternative, like Alternatives 1 and 2, would provide for rapid recovery of the riparian habitat by providing cover for fish and stream shading for temperature moderation. Compared to Alternatives 1 and 2, approximately 12 acres (about 0.9 linear miles) less would be treated. Conifer and deciduous trees in the riparian zone would begin to meet habitat needs in 15-20 years. Fish populations would recover at a slightly lower rate in Hunter creek than in Alternatives 1 and 2.

1. Herbicide: This alternative calls for 671 less acres sprayed than Alternative 2 and no aerial herbicide treatments which would result in slightly more shrub and hardwood habitat for a longer time frame compared to Alternatives 1 and 2. These effects are described below and in Table IV-7.

2. Oak and Conifer Management: This alternative would provide more oak emphasis than Alternative 1, by retaining 36 sqft/acre oaks on 2,374 acres located in areas of concentrated deer herd winter range and 20 sqft/acre oaks on 807 acres located in deer herd migratory corridors.

   a. This would provide similar medium-high oak habitat capability for western gray squirrel mountain quail as Alternative 2.

   b. Provide deer cover:forage ratio of 60:40 with a capability of at least 2,000 animals in the winter.

c. Provide seventy percent of the habitat needs for pileated woodpecker, and 80 percent of the habitat needs for white-headed woodpecker, compared to Alternative 1.

d. Provide goshawk and spotted owl habitat needs for 2 pair and 6 pair respectively in 100-150 years.

3. Broadcast Burning: This alternative would have less impact on wildlife from burning that Alternatives 1 and 2 since 456 acres would be burned for fuels reduction prior to planting. The 671 acres that would be "browned and burned" in Alternatives 1 and 2 are eliminated from this alternative (refer to Chapter II, Treatment Maps for Alternatives 1-3).

Cumulative Effects

1. Compared to Alternatives 1 and 2, effects resulting in a reduction of certain habitat components over time are less. Brush and grass are expected to be less effectively controlled.

2. Other effects are equivalent to those described for Alternatives 1 and 2.

Alternative 4

This alternative would reforest 3,944 acres without using herbicides. It would be the most beneficial action alternative for western gray squirrel and mountain quail, which depend on hardwood and shrub habitats. It would be comparable with Alternatives 2 and 3 for mule deer. Since this alternative is limited to manual treatments of areas already planted, these hardwood and shrub habitats would persist as conifers slowly reestablish themselves on untreated sites. Of all the action alternatives, it is the least beneficial for goshawk, spotted owl and the cavity-nesting birds because of the slower recovery of conifer habitats. It would have no potential impact to wildlife from chemical sources.

Direct Effects

1. Broadcast burning would occur on 2,205 acres outside reforested areas. Burning has the highest potential for wildlife fatality.

2. Hand grubbing may affect the survival of one or more individuals, particularly if ground nesting birds or small mammals are living on, or near, the site. No impacts on large mammals are expected.

Indirect Effects

1. Manual vegetation control: This alternative calls for hand release, instead of herbicide treatments, on significantly less acreage than the other three action alternatives. It would also promote hardwood and shrub dominated vegetation types in the project area for a longer period of time compared to the other action alternatives. The effects on habitat capability are described below and in Table IV-7.

2. Oak and Conifer Management: Provide greater oak emphasis than Alternatives 1, 2 and 3 by limiting reforestation to 3,944 acres and allowing the remaining

acres to revert to natural recovery. This would provide medium to high oak habitat capability on 10,010 acres for western gray squirrel and high capability habitat on 7,650 acres for mountain quail.

a. Provide deer cover:forage ratio of 51:49 with a capability of at least 2,000 animals in the winter.

b. Provide 40 percent of the habitat capability for pileated woodpecker, and 50 percent capability for white-headed woodpecker as compared to alternative 1.

c. Goshawk and spotted owl habitat capability at 2 pair and 4 pair respectively in 100-150 years.

3. Broadcast burning effects could occur on 2,205 acres. Refer to Alternative 1 for general burning indirect effects.

Cumulative Effects

Most of the project area would be left to recovery naturally, which would provide vast amounts of oak and shrub habitats. Planted sites would soon be occupied with grass, forbs, and shrubs that mimic thos found on the remaining acres.

The greatest management concern would be the delayed period for recovery to mature conifer-dominated stands, of importance to several Forest Service Sensitive species. Conifer-dominated stands will not occur for many decades. Planted stands may provide some acreage within 50-80 years, while unplanted stands will not provide any acreage for more than 150 years.

Alternative 5. Alternative 5 (No Action) would provide:

This alternative would abandon reforestation practices with 3,780 acres planted. It would be most beneficial to species such as western gray squirrel and mountain quail but other species such as deer would suffer from poor cover habitats and mature forest species such as goshawk, spotted owl, and the two woodpeckers would suffer poor habitat capability for a much longer period of time than under the action alternatives. Similarly, trout habitat would take longest to recover under this alternative because of the importance of conifers to stream shading.

Direct Effects

There would be no direct effects to wildlife under this alternative.

Indirect Effects

1. This alternative would provide the greatest amount of hiding cover for many wildlife species, including high mountain quail and gray squirrel, due to the amount of oak/shrub habitats.

2. Provide deer cover:forage ratio of 28:72 for the near future, representing a low capability for deer, only slightly better than Alternative 1. The 28 percent cover habitat would be poorly distributed which would further decrease its capability for deer.

3. Provide the lowest capability for white-headed and pileated woodpecker.

4. Provide the lowest capability for future goshawk and spotted owl potential within the the next 150 years.

5. Foster natural riparian recovery resulting in a brush dominated riparian zone which would retard full recovery of shade-producing trees. Water temperatures would be higher and stream surface shading lower. Recovery of the stream habitats to full capability probably would not occur for 50-75 years.

Cumulative Effects

Overtime, biodiversity would be negatively affected due to the much delayed timeframe for recovery of forest habitats. Hardwood and shrub types would dominate suitable timber sites for a considerable period of time. This would delay use by wildlife species that require mature forest conditions.

Cumulative effects from to past fires in adjacent areas would not be reduced as in Alternatives 1, 2, and 3 due to the lack of a conifer forest for a longer period of time.

TABLE IV-7: COMPARISON OF POTENTIAL HABITAT CAPABILITY BY SELECTED MANAGEMENT INDICATOR SPECIES

Species	Alt 1	Alt 2	Alt 3	Alt 4	Alt 5
Mule Deer(cover:forage) Quality rating 30yr+0	93:7 Low	63:37 High	60:40 High	51:49 High	28:72 Low
Gray squirrel (M-H oak) Est. Animal Capability	3444 ac 2860	7716 ac 3680	7716 ac 3680	10010 ac 5000	13,150 ac 6075
Mountain quail	1100 ac (high capability 10-100 yr)	3930 ac	3930 ac	7650 ac	10,930 ac
White-headed woodpecker Post-fire Year 30 (tree age) Year 40	 105 pr 105 pr 460 pr	 105 pr 105 pr 361 pr	 105 pr 105 pr 361 pr	 105 pr 105 pr 230 pr	 105 pr 105 pr 116 pr
Pileated woodpecker Post-fire Year 60 Year 75	 2 pr 10 pr 36 pr	 2 pr 6 pr 26 pr	 2 pr 6 pr 26 pr	 2 pr 1 pr 14 pr	 2 pr 3 pr
Goshawk Post-fire Year 75 Year 100	 1 pr 2 pr 3 pr	 1 pr 2 pr 2 pr	 1 pr 2 pr 2 pr	 1 pr 1 pr 2 pr	 1 pr 1 pr 1 pr
Spotted owl Post-fire Year 75 Year 150	 2 pr 4 pr 6 pr	 2 pr 3 pr 6 pr	 2 pr 3 pr 6 pr	 2 pr 2 4 pr	 2 pr 2 3 pr
Yellow warbler & other Riparian Spp capability	264 ac/on perennials	same + Intermitent	252 ac/on Intermitent	low	lowest
Trout Capability Recovery rate	 high	 high	 high	 med	 low
Fisher Capability Year 75 +	 low	 med	 med	 low	 low
Red Fox Capability Year 75+	 low	 med	 med	 low	 low

L. Unavoidable Adverse Effects

As indicated in the earlier discussion of environmental consequences, all of the alternatives, including the No Action Alternative, yield adverse effects to some resource categories.

Alternatives that include burning treatments will generate smoke and particulate matter. While burning prescriptions are designed to encourage dilution and dispersion of smoke, nearby residents may be affected, especially if they are sensitive to smoke.

Soil erosion, although expected to be minimal, will occur if burning and/or vegetation treatments occur. As the productivity of the soil is a key component driving the growth and vigor of the forest, treatments are designed to protect the soil resource.

Wildlife habitat will be changed by any alternative. In alternatives that treat/remove vegetation, animals that favor dense brushfields will be adversely affected. In alternatives that do not promote the reestablishment of conifers, animals that favor conifer habitat will be adversely affected.

During the period when herbicide-treated vegetation maintains the browned foliage, the quality of scenery may decline. Areas treated by hand clearing will also look unnatural to forest visitors.

Given the relationships between all the plants and animals that use the project area, it is reasonable to expect that numerous other adverse effects will occur. It is believed that these are all minimal.

M. Relationship of Short-term Uses and Long-term Productivity

The inherent productivity of the project area will not be compromised by any alternative. The set of alternatives will all protect soil productivity. Each alternative varies in it's ability to provide for forest productivity, with the No Action alternative making very little contribution to forest productivity. Wildlife habitat, especially with regard for mule deer, is enhanced by the increasing levels of hardwoods. This would increase up to the point where associated brushfields become dense enough to physically exclude them from some of the hardwoods.

N. Irreversible and Irretrievable Commitments of Resources

Each passing year without effective reforestation of conifers provides for irreversible and irretrievable losses in potential wood product production. Among the alternatives, those that reforest more acres, with more effective treatments, minimize this loss. Related to this, animals that favor conifer habitat are likewise affected.

The cost of implementing any action alternative, as compared to the value of the wood products alone, is expected to exceed potential revenues. Values of forested landscapes, excluding wood product values, are not estimated. The inclusion of these values would reduce, perhaps eliminate, this imbalance. Nevertheless, any costs incurred are at risk of being unrecoverable.

V. LIST OF PREPARERS

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APPENDIX 1
PAPER REFORESTATION ENVIRONMENTAL IMPACT STATEMENT
Site Specific Human Health Risk Assessment
September 1993

PURPOSE

Herbicide use is proposed in Alternatives 1, 2, and 3. Alternatives 1 and 2 would treat an estimated 10,820 acres of aerial and ground, and 930 acres of only ground herbicide applications. Alternative 3 would have an estimated 11,079 acres of ground applications.

The Pacific Southwest Region's FEIS for Vegetation Management for Reforestation (R5-FEIS), Appendix F - Human Health Risk Assessment, pages F-1 to F-173, estimates the risks of average and maximum rate usage of 13 herbicides. That assessment included the three herbicides proposed for use in this project.

The Record of Decision for the Pacific Southwest Region's Final Environmental Impact Statement for Vegetation Management for Reforestation (R5-FEIS) states that worker exposure must be assessed in site specific analysis. The risk assessment in the R5-FEIS (Appendix F - Human Health Risk Assessment, pages F-1 to F-173) assessed the human health risk for 13 herbicides for average application rates and maximum legal application rates. These documents are incorporated by reference into this risk assessment in accordance with 40 CFR 1502.21 and are available for review. Site specific analyses need to be completed for individual site specific vegetation management programs.

The purpose of this risk assessment is to assess the site specific risks to human health and safety associated with this project proposal. Information about the proposed applications are summarized below. Application rates are intended to represent the maximum that would be applied.

Table 1-1 - Herbicide Information Summary

Chemical	Product	Application Rate	Additives
Glyphosate	Accord	2% solution in 25 gallons of water per acre, applying about 1.5 lbs/acre (AI)	Non-ionic surfactant such as R-11 or MOR-ACT, with a colorant such as Hi-Light
Triclopyr	Garlon 4	1% solution in 25 gallons of water per acre, applying about 1 lb/acre (AI)	Non-ionic surfactant such as R-11 or MOR-ACT, with a colorant such as Hi-Light
Hexazinone	Pronone	35 pounds/acre, applying about 3.5 lbs/acre (AI)	None
	Velpar L	Rates would be less than or equal to the above rates, so this assessment will be for the application rate listed for Pronone	None

Water is the carrier for Accord, Garlon 4, and Velpar L spray solutions. Pronone 10G, a granular formulation, is applied as packaged. A surfactant will be used with the Accord and Garlon 4 formulations utilized to improve the absorption of the active ingredient into the plant tissue. Application rates are the average amount of material to be applied per acre. Pronone 10G and Velpar L formulations, containing hexazinone, are applied at rates determined by the soil texture and organic matter content. Regardless of the herbicide formulation being used, EPA and State-approved labels will guide usage.

OVERVIEW

This site-specific risk assessment uses standard methodology widely accepted by the scientific community, regulatory agencies, and the Forest Service (R-5 FEIS, pages 4-62 to 4-122 and Appendix F; NRC, 1983; EPA, 1986b). In essence, the risk assessment compares herbicide doses that people might receive from applying the herbicides (worker doses) or from being near an application site (public doses) with doses shown to cause no observed ill effect (NOEL) in test animals in long-term laboratory studies. The risk assessment examines the chance, based on site-specific herbicide use levels, that exposures from these herbicide formulations will result in acute, systemic, or reproductive effects or cause cancer. The site-specific risk assessment also examines the potential for these treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals including women and children.

This risk assessment uses the analytical elements described by the National Research Council (1983): hazard analysis, exposure analysis, and risk analysis. *Hazard analysis* focuses on determination of the toxic properties of each herbicide. Human hazard levels are derived primarily from results of laboratory experiments on animal models, supplemented where appropriate with information on human poisoning incidents, epidemiology studies, and data on chemical structure. *Exposure analysis* estimates exposures to people potentially exposed to the herbicides, determines the doses likely to result from those estimated exposures, and determines the number and characteristics of people in the exposed populations. *Risk analysis* combines the hazard information with the dose estimates and the probability that they could occur to predict health effects to individuals under the given conditions of exposure (R-5 FEIS Appendix F, page F-2 to F-3).

HAZARD ANALYSIS

The toxicological data base for each herbicide was reviewed for acute, reproductive, and chronic effects on test animals. Toxicity information is summarized for the herbicides being considered for use on this project in the background statements of Forest Service Agricultural Handbook No. 633 (U.S.D.A., 1984). Information concerning glyphosate is found on pages G-1 through G-72 in the background statements. Information about triclopyr is found on pages T-1 through T-61. Information on hexazinone is found on pages H-1 through H-86. Toxicity and cancer potency information for the proposed herbicides can also be found in Table F-41 on page F-116 of the R-5 FEIS, Appendix F.

The most likely adverse health effects resulting from significant exposures to glyphosate and triclopyr include skin and eye irritation although nausea, diarrhea and cramps have been reported for oral ingestion of glyphosate. Significant exposures to hexazinone may produce eye irritation, and there has been one case reported that involved the inhalation of "....hexazinone dust (concentration not specified) where vomiting occurred within 24 hours. No other effects were reported and no treatment was administered." (R5 FEIS, pages F-58-F-62).

Glyphosate is classified as slightly toxic based upon an acute oral LD_{50} of 4,320 mg/kg for rats. The dermal LD_{50} for rabbits exposed to pure glyphosate is greater than 5,000 mg/kg. Glyphosate is not a primary skin irritant and is only minimally irritating to the eye. Laboratory studies have shown that excessive exposure may cause kidney and liver damage. The EPA established a systemic NOEL of 31 mg/kg/day for these effects (R-5 FEIS, p. F-58). There is no evidence that glyphosate causes birth defects. The reproductive NOEL of 10 mg/kg/day is based on a three generation reproduction study in rats (R-5 FEIS, p. F-58). This NOEL was based on kidney effects in rat pups rather than any effects in reproductive parameters. The Environmental Protection Agency (EPA) Science Advisory Panel recommends that Glyphosate not be classified as carcinogenic **(EPA 1992)**; although, the R-5 FEIS assumed that it is carcinogenic. The cancer potency value for glyphosate is 0.00035 per (mg/kg/day) (R-5 FEIS, p. F-116).

Triclopyr is classified as moderately toxic based upon an acute oral LD_{50} of 630 mg/kg for rats. The dermal LD_{50} for rabbits is greater than 2,000 mg/kg. Triclopyr is a mild skin irritant and slight to moderate eye irritant. Laboratory studies have shown that excessive exposure may cause liver or kidney damage. The Environmental Protection Agency set a systemic NOEL of 2.5 mg/kg/day for such effects (R-5 FEIS, p. F-74). Triclopyr does not cause birth defects, and it has not been shown to cause cancer (R-5 FEIS, p. F-75). The reproductive NOEL of 2.5 mg/kg/day is based on fetotoxic effects seen at higher doses in both rabbits and rats (R-5 FEIS, p.F-75).

Hexazinone is considered slightly toxic to humans and other animals based on an acute oral LD_{50} of 1,690 mg/kg (VMFEIS, page F-62). Hexazinone is an eye irritant but not a skin irritant. Laboratory studies have shown that excessive exposures over a lifetime may cause liver damage and reduced weight gain. The Environmental Protection Agency (EPA) set a systemic NOEL of 10 mg/kg/day for these effects. There is no evidence hexazinone causes birth defects in animals (VMFEIS, page F-64). A reproductive NOEL of 50 mg/kg/day is based on fetotoxic effects seen at higher doses in rats (VMFEIS, page F-64).

Recently, the EPA reviewed existing toxicity data and re-classified hexazinone as a "possible carcinogen" (Class C - limited evidence from animal studies in the absence of human data). This reclassification was based on further analysis of liver effects (tumors) observed at very high doses (10,000 ppm) over the lifetime of a mouse chronic-feeding study. The exposure levels used in this study were higher than those projected for human exposure. Chronic exposures of mice to lower doses did not produce tumors. Comparable studies with other laboratory species did not result in tumor production. Based on weight-of-evidence, EPA has chosen not to determine a potency value, but to establish instead, a reference dose (Rfd) of 0.05 mg/kg/day (Rinde and Dykstra 1992). Hexazinone does not present a mutagenic hazard to humans (VMFEIS, page F-64).

The acute toxicities of the five metabolites (Metabolites A-E) of hexazinone have been tested and found to be very slightly toxic. The chemical names and average lethal doses can be found in Forest Service Agriculture Handbook Number 633, p. H-73.

EXPOSURE ANALYSIS

Exposure analysis was accomplished by identifying the people likely to be exposed as a result of this project and then estimating doses for these potentially exposed individuals. This analysis uses the actual application rates of glyphosate, triclopyr and hexazinone proposed for this project.

Those potentially at risk fall into two groups: workers and members of the public. Workers include applicators, supervisors, and other personnel directly involved in the application of herbicides. The public includes forest visitors or nearby residents who could be exposed through drift of the liquid herbicides (glyphosate, hexazinone-Velpar formulation, and triclopyr) or through dust from the granular herbicide (hexazinone-Pronone formulation); through contact with sprayed vegetation; by eating food items such as berries growing in or near treated areas; by eating game or fish containing herbicide residues; by drinking water that contains such residues (R-5 FEIS Appendix F, page F-1) or by inhaling smoke from burns of areas treated with herbicides. The most likely individuals to be exposed to herbicides during and after this project are the backpack applicators applying the treatments, residents who live near the treatment areas and visit the sites, hikers and backpackers, hunters, fisherman, nature students, and firewood gatherers.

County assessor records for Tuolumne County were obtained to estimate the total number of households within 1/4 mile of any one treatment unit. Any exposure from a herbicide spray project to residents living beyond one-quarter mile from treatment sites would be negligible (R5 FEIS, pages F-79 -F-81). Based on this, 80 people are estimated to live near or adjacent to treatment units. Recreational use of this portion of the District is not as heavy as other areas. This is due to the combination of higher summer temperatures, relatively poor road access during the winter, and the sparsity of key destination spots. No hiking trails are known to exist in the stands to be treated and overall hiking use is low due to the above factors. Use associated with deer hunting may be the single largest pulse of public activity. Even this, however, may only attract about 200 people. Dispersed camping, in undeveloped campsites along roads, may amount to another 200 people per year. Firewood cutting is now very low due to the overall lack of supply in this area.

During the last two years of herbicide application on this Forest, the majority of backpack applicators have been non-local. Crews generally work for contractors who have successfully bid on Forest Service reforestation projects. These crews often travel over wide geographic areas as they complete work for various property owners, as well as for the Forest Service. The crew size needed to complete this project within the effective treatment window is estimated to range from a minimum of 5 to a maximum of 30 individuals (see further discussion on workers in the section on cancer risks).

Following the same procedures as used in the R-5 FEIS (pages F-78 to F-111) and based on site-specific herbicide use levels, doses were calculated for potentially exposed workers and members of the public and are displayed in Tables 1-2 through 1-5. Dose estimates are based on actual field studies of worker exposures and public dose estimates have been extrapolated from the worker exposure data (R-5 FEIS, p.F-78 to F-111). Dose estimates for hexazinone and glyphosate are based on the same exposure data used in the R-5 FEIS. Dose estimates for triclopyr are based on newer exposure data for triclopyr submitted by Dow Chemical to the Forest Service (2150 letter dated June 27, 1989 from the Regional Forester to Forest Supervisors on Herbicide Use: Triclopyr). **All doses are at low levels.**

The toxicological data for hexazinone and glyphosate are identical to the values utilized in the R5-FEIS Appendix F. The toxicological data for triclopyr has been supplemented with new data submitted by Dow Chemical to the Forest Service, and was transmitted to the Stanislaus National Forest by the Regional Forester on June 27, 1989. Dow provided the Forest Service with new exposure data for triclopyr, and that new data was used in this risk assessment.

Exposure from Brown-and-Burn Operations

For the proposed project, burning is scheduled after application of hexazinone. No data was available for hexazinone concentrations, however in a field study involving prescribed burning on sites treated

with the Pronone 10G formulation of hexazinone, no herbicide residues were detected in the smoke samples from any of the fires in the study (McMahon and Bush, 1991).

The health risks from potentially toxic pyrolysis products of the herbicides are negligible because the amount of the parent compound available for burning is low after two months; and of the material burned, the combustion products of concern would constitute a minute fraction of the total volume of pyrolysis products (R5-FEIS, Appendix F, page F-90).

RISK ANALYSIS

Risk analysis was accomplished by comparing the dose levels estimated in the Exposure Analysis section with the toxic effect levels described in the Hazards Analysis section. For threshold effects like systemic and reproductive effects, a margin-of-safety (MOS) approach is used to quantify the potential risks to the health of workers and members of the public from the proposed applications of glyphosate and triclopyr. For non-threshold effects like cancer, the risk is quantified by multiplying a laboratory determined probability of cancer per unit lifetime dose (cancer potency) by an estimated lifetime dose.

Systemic and Reproductive Effects:

A MOS was calculated for each dose estimate for workers and members of the public by dividing the systemic and reproductive NOEL for the three herbicides by the estimated dose (see Tables 1-2 through 1-5). A benchmark MOS of 100 is commonly accepted by the scientific community, regulatory agencies, and the Forest Service for setting acceptable dose levels. To allow for the uncertainty in extrapolating from the NOEL in laboratory test animals to safe levels for humans, additional safety factors are used. The generally accepted factors (NRC, 1986) are 10 for extrapolating from an animal model to humans and an additional factor of 10 to account for possible variation within the human population. This 10 times 10 or 100-fold safety factor means that the laboratory NOEL reduced 100-fold normally would be considered a safe dose for humans. All MOS values calculated for doses resulting from the proposed site-specific herbicide treatments are equal to or greater than 100 (see Tables 1-2 through 1-5). **Based on the benchmark value, all proposed applications pose an acceptable or low risk to human health and safety.**

To err on the side of safety, this risk assessment has been designed to overestimate risks. For example, comparing one-time or short duration exposures (such as those experienced by the public) to NOELs derived from lifetime exposure studies tends to overestimate the risks (R-5 FEIS Appendix F, page F-1 to F-2). In addition, it is unlikely that any member of the public or worker would receive as high a dose as estimated in this analysis.

For example, the dose estimates calculated for forest workers in the R-5 FEIS and this site-specific risk assessment are based on data where workers wore no special protective clothing. Scientific studies show that mitigation, such as the use of protective clothing can reduce exposure, and therefore risk, from these types of treatments by 27 to 99 percent (R-5 FEIS, page F-140). Even though the dose values calculated for this risk assessment are very low, the use of protective clothing would further reduce worker exposure, especially to the mixer/loaders.

Specific mitigations measures planned for this project that will reduce risks to workers include:

> All Forest Service workers (such as inspectors) would be required to meet State regulations and wear minimum protective clothing, wash their clothes daily, and change clothes when not on the project site.
>
> Workers using triclopyr must wear additional protective clothing while mixing, loading, or hand-applying.
>
> Clean water and soap for routine washing of hands and face and for emergency washing would be supplied, following State regulations.
>
> Forest Service workers would be instructed in safety procedures and review Material Safety Data Sheets, following Federal regulations prior to application.

In reality, workers are likely to receive some low-level doses because they work with the chemicals routinely. However, standard safety practices and the use of protective clothing normally will reduce their actual dose levels below those estimated in this analysis. The same is true of the doses received from any spraying or spill accidents that might occur, because the normal procedure, as specified in the implementation plan or spill plan prepared for programs involving the use of pesticides, would be to wash the chemical off immediately (R-5 FEIS Appendix F, page F-2).

It is also unlikely that a member of the public would receive a dose as high as is estimated in this risk assessment. For example, this risk assessment assumed that members of the public do not wash themselves or their food items following exposure to a herbicide, and that they consume water that has received herbicide from drift or a spill immediately after the event, despite any evident odor or discoloration. Common hygiene practices would reduce the chance of receiving the doses estimated in this analysis.

In addition, risk of exposure is relatively low due to several other factors: many of the sites are far from areas typically used by the public so few people have potential to be exposed, access to the treated areas would be controlled, and various mitigation measures contribute to reducing exposure of anyone entering treated areas. Specific mitigation measures to reduce exposure to the herbicides and to reduce health risks to the public include:

> "No treatment" buffers have been applied when herbicides are used near perennial, intermittent, or ephemeral streams to reduce the potential for contaminated water.
>
> "No aerial application" buffers have been applied adjacent to private property to reduce the potential of drift of herbicides onto the private property. These areas will be treated with a hand application of herbicides instead.

Roads and hiking trails would be avoided during applications.

Prohibiting aerial applications when wind velocities exceed 6 miles per hour is expected to eliminate exposure from drift.

Signs would be posted at areas of common public access prior to treatment as is required by State regulations.

Access to the stands would be restricted until after the spray solution has dried or been absorbed, as required by State regulation.

Before spraying, the sites would be inspected for the presence of people.

For threshold effects, this site-specific risk assessment tends to exaggerate the real risks to workers and the public by the way exposures are estimated and the way risks are judged (R-5 FEIS Appendix F, page F-2).

Table 1-2 Predicted dose (mg/kg/day) and MOS for workers and publics in aerial applications of hexazinone.

Application Rate (lb/acre)	Dose 3.50	MOS (systemic)	MOS (reproductive)
Exposed Individuals:			
WORKERS			
Pilots	0.025	400	2,000
Mechanics	0.0074	1,400	6,800
Batchmen	0.029	340	1,700
Supervisors	0.0021	4,800	24,000
Observers	0.00052	19,000	96,000
GENERAL PUBLIC			
Outside Spray Area	0.012	830	4,200
Spray	0.0000052	1,900,000	9,600,000
Dietary	0.012	830	4,200
Inside Spray Areas	0.013	770	3,800
Spray	0.00052	19,000	96,000
Dietary	0.012	830	4,200
Forest Users	0.017	590	2,900
Inhalation	0.0000081	1,200,000	6,200,000
Gatherers	0.0049	2,000	10,000
Dietary	0.012	830	4,200
Nearby Resident	0.017	590	2,900

Table 1-3 Predicted dose (mg/kg/day) and MOS for workers and publics in ground applications of glyphosate.

Application Rate (lb/acre)	Dose 1.50	MOS (systemic)	MOS (reproductive)
Exposed Individuals:			
WORKERS			
Backpack	0.044	700	230
GENERAL PUBLIC			
Inside Spray Area	0.0079	3,900	1,300
Spray	0.00022	140,000	45,000
Dietary	0.0076	4,100	1,300
Forest Users	0.0098	3,200	1,000
Inhalation	0.0000034	9,100,000	2,900,000
Gatherers	0.0021	15,000	4,800
Dietary	0.0076	4,100	1,300
Nearby Resident	0.01	3,100	1,000

Table 1-4 Predicted dose (mg/kg/day) and MOS for workers and publics in ground applications of hexazinone.

Application Rate (lb/acre)	Dose 3.50	MOS (systemic)	MOS (reproductive)
Exposed Individuals:			
WORKERS			
Backpack	0.1	100	500
GENERAL PUBLIC			
Inside Spray Area	0.018	560	2,800
Spray	0.00052	19,000	96,000
Dietary	0.018	560	2,800
Forest Users	0.023	430	2,200
Inhalation	0.0000081	1,200,000	6,200,000
Gatherers	0.0049	2,000	10,000
Dietary	0.018	560	2,800
Nearby Resident	0.023	501	2,200

Table 1-5 Predicted dose (mg/kg/day) and MOS for workers and publics in ground applications of triclopyr.

Application Rate (lb/acre)	Dose 1.00	MOS (systemic)	MOS (reproductive)
Exposed Individuals:			
WORKERS			
Backpack	0.0081	310	310
GENERAL PUBLIC			
Inside Spray Area	0.0015	1,700	1,700
Spray	0.000042	60,000	60,000
Dietary	0.0014	1,800	1,800
Forest Users	0.0018	1,400	1,400
Inhalation	0.00000064	3,900,000	3,900,000
Gatherers	0.00039	6,400	6,400
Dietary	0.0014	1,800	1,800
Nearby Resident	0.019	1,300	1,300

All of the margins of safety (MOS) calculated for the 3 herbicides proposed for use meet, or exceed, 100 for normal Forest applications. Therefore, the risk of adverse health effects is believed to be low (R5-FEIS p. 4-82). MOS values for glyphosate are smaller than those in the R5-FEIS because the application rate is higher.

Risk to Sensitive Individuals.

The margin-of-safety approach used in this risk assessment takes into account much of the variation in human response. The normal MOS of 100 is sufficient to ensure that most people will experience

no toxic effects. "Sensitive" individuals are those that might respond to a lower dose than average, which includes women and children. Individuals that may be sensitive to herbicides may not be covered by an MOS of 100 because human susceptibility to toxic substances can vary by two to three orders of magnitude.

Factors affecting individual susceptibility include diet, age, heredity, pre-existing diseases, and life style. Individual susceptibility to the herbicides proposed in this project cannot be specifically predicted. Unusually sensitive individuals may experience effects even when the MOS is equal to or greater than 100. Since sensitive individuals compose only a fraction of the population at large (other than children and women), because only a very small portion of the public is likely to be exposed to these applications, and because MOS values are much greater than 100 (430 to 9 million) for public exposures, adverse effects to the public are not expected. Further information concerning risks to "sensitive" individuals can be found on pages 4-114 through 4-116 in the R5-FEIS.

The benchmark MOS of 100 used in the R-5 FEIS and this site-specific risk assessment accounts for women, children, and other sensitive individuals. In essence, the benchmark of 100 reduces the NOEL values by ten to account for differences between laboratory animals and humans, and by another factor of ten to account for variation among humans.

The Health Advisories (HA) developed by the Environmental Protection Agency (1988) provide another approach to assess health risks to sensitive individuals. Health Advisories describe concentrations of contaminants in drinking water at which adverse health effects are not anticipated to occur over specific exposure durations. Health Advisories contain a 100-fold margin of safety to protect sensitive individuals in a population, which include women and children; and the longer-term and lifetime HAs provide estimates of an acceptable daily intake. For each proposed herbicide, longer-term and lifetime HAs were calculated for both men and women based on different average body weights, and a longer-term HA was calculated for small children. A Health Advisory was issued for glyphosate and hexazinone (EPA 1988a,b). While a HA has not been published for triclopyr, HA values were calculated using the same methodology that was used for glyphosate.

Glyphosate:

Longer-term Health Advisory:
1.0 mg/L for a 10 kg child
2.5 mg/L for a 50 kg adult (woman)
3.5 mg/L for a 70 kg adult (man)
Lifetime Health Advisory:
0.5 mg/L for a 50 kg adult (women)
0.7 mg/L for a 70 kg adult (man)

Triclopyr:

Longer-term Health Advisory:
0.25 mg/L for a 10 kg child
0.62 mg/L for a 50 kg adult (woman)
0.88 mg/L for a 70 Kg adult (man)
Lifetime Health Advisory:
0.18 mg/L for a 70 kg adult (man)
0.12 mg/L for a 50 kg adult (woman)

Hexazinone:

Longer-term Health Advisory:
2.50 mg/L for a 10 kg child
6.25 mg/L for a 50 kg adult (woman)
8.75 mg/L for a 70 kg adult (man)
Lifetime Health Advisory:
0.15 mg/L for a 50 kg adult (woman)
0.21 mg/L for a 70 kg adult (man)

All calculated doses to members of the public and workers (Tables 1-2 through 1-5) are less than the HA values calculated for men, women, and children.

Based on the Health Advisories and calculated MOS values from Tables 1-2 through 1-5, the proposed herbicide treatments pose a low risk to women, children and other sensitive individuals.

Cancer Risk

A different approach is used to assess the risks to humans from chemicals that may cause cancer. For such chemicals, which have no comparable no-effect-level, we assume that any dose, no matter how small, has some probability of causing cancer (R-5 FEIS, Appendix F, pages F-141 to F-168). To estimate the lifetime cancer risk for an individual exposed to a herbicide we need to know the cancer potency value of the herbicide and the individual's lifetime average daily dose of the herbicide.

The cancer potency of a given herbicide is defined as the increase in likelihood of getting cancer from an increase in the dose of the herbicide. Cancer potency values reflect the probability or chance of getting cancer sometime in a person's lifetime for each dose (mg/kg/day) of a chemical that a person is exposed to. Cancer potency values are determined from laboratory animal studies and adjusted for the differences in body weight and lifetime duration between the laboratory animals and humans. Of the three herbicides proposed for this project, only glyphosate has an associated cancer potency value (R-5 FEIS, Appendix F, Table F-41, page F116). There is even scientific uncertainty about the risk of cancer from glyphosate (R-5 FEIS Appendix F, page F-141). However, once again we err on the side of safety and make the conservative assumption that glyphosate does cause cancer and that its potency value is 3.5×10^{-4}.

The lifetime average daily dose (LADD) is a product of the estimated daily dose (see Tables 1-2 through 1-5) resulting from a given type of public exposure or type of work times the number of days that the exposure occurs over a lifetime divided by the total number of days in a 70-year lifetime. Considering the make up of the public that has the potential to be exposed from this project, nearby residents who may also be effected water users would be exposed for the greatest number of days because they are permanent users of the project area while the other groups are transient users. The R5-FEIS (pages F-146 and F-150) describes the potential exposure of residents who live adjacent to the forest as being 3, 6, or 9 days in a lifetime for the realistic, conservative, and worst cases. Based on the residential development in the project area and the possibility that many sites within a drainage might be treated over time, it was felt that 9 days represented the project situation better than the realistic case. This scenario assumes a resident might be exposed when a herbicide was used on 3 different sites, each treated three different times.

Following the same methodology used in the R5-FEIS, lifetime cancer risk from applying glyphosate on this proposed vegetation management project was calculated for forest users, hikers, and nearby residents based on the maximum herbicide application rate of 1.5 pounds of active ingredient (AI) per acre.

Table 1-6 Estimated Cancer Risk for the General Public

	From R5-EIS TableF-41	From Table 1-3	Exposures/Days in a 70 Year Lifetime	Persistence Factor	Risk
Forest Users	0.00035	0.0098	70/25,550		9.4X10^{-9}
Hikers	0.00035	0.0098	70/25,550	27	2.5X10^{-7}
Nearby Resident	0.00035	0.01	9/25,550	27	3.3X10^{-8}

Cancer risk values that are 1 in 1 million or less are considered negligible (R-5 FEIS page 4-83). The only established risk level in the State of California is found within the Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65), and it defines no significant cancer risk as "one excess case in an exposed population of 100,000..."

The calculations for public lifetime individual cancer risk indicate risks of less than 1 in 1 million. Nearby residents have a cancer risk of 1 chance in 30 million (3.3 x 10^{-8}) and hikers (backpackers) have a cancer risk of 1 chance in 4 million (2.5 in 10 million). **Based on the benchmark value of 1 in 1 million, the proposed treatments of glyphosate appear to present a negligible risk of cancer.**

While nearby residents have the greatest potential for exposure from this project, the methodology used in the R5-FEIS assumes that forest users and hikers would be exposed to some project every day they visit a forest. The assumption greatly increases the estimated lifetime average daily dose and the lifetime individual cancer risk for them. Even though the calculations indicate nearby residents are at somewhat lower risk than hikers, they are the group of greatest concern from a risk standpoint because there are no attractions to encourage people to walk to most units.

The R5-FEIS describes the assumptions about workers typically involved in carrying out vegetation management projects involving chemical methods as someone who is exposed 60 days a year during a 30 year career (see pages 4-103 and 4-104). However, this is generally recognized as an unlikely scenario because most people change jobs during a 30-year career.

Following the same methodology used in the R5-FEIS, lifetime cancer risk values were calculated for workers exposed over the five years. This one-time or project exposure is compared against the 30-year career exposure using the maximum herbicide application rate of 1.5 pounds of AI per acre.

The following discussion describes the estimation of cancer risks to workers. There are an estimated 12,617 acres of glyphosate application in Alternative 1, which has the most acres proposed for glyphosate application. The proposal would carry out the applications over four years.

To determine the cancer risk to any single worker, the maximum number of days a worker is likely to be exposed over this project must be used. It is reasonable to assume that a worker could be involved in seven applications over four years (two each year for the first three years, followed by a single treatment in the last year):

Under Alternative 1, in 1994 the 133 acres receiving the first glyphosate treatment would require at least 2 people to complete within 30 days, and the second treatment of 476 acres would require 4 people; in 1995, one person would be needed to complete the first treatment within 30 days, and 57 people for the second treatment; in 1996, one person would be needed for the first treatment and 18 for the second treatment; in 1997, a minimum of 25 people would be needed. Therefore, it is possible that one person could be exposed for a maximum of 210 days. **This means that the maximum cancer risk from this project to a worker, who would have the greatest risk of anyone exposed to herbicides by this project, would be $3.5x10^{-4}$ x $4.4x10^{-2}$ x 210/25,550 = $1.3x10^{-7}$ or about 1 chance in 7 million.** This assumption is based on a treatment rate of 4 acres per day per worker and a treatment window of 30 days each year per application.

Table 1-7 **Maximum lifetime individual cancer risk for workers exposed to glyphosate.**

Exposure Scenario	Potency from Table F-41 X (R-5 FEIS)	Dose from Table 1-2 X (Page)	Days Exposed/ No. Days in 70 Year Lifetime	= Estimated Risk
Project (4 years)	0.00035	0.044	210/25,550	$1.3x10^{-7}$
30 Year Career	0.00035	0.044	1800/25,550	$1.1x10^{-6}$

The Environmental Protection Agency and the California Department of Food and Agriculture accept a cancer risk rate of 1 in 1,000,000 as an acceptable risk. **The values calculated in this analysis are above 1 in 1,000,000 (.000001, or 1 X 10-6).** The "30 Year Career" value assumes that the same workers would make the same glyphosate treatments every year for a 30 year career over a 70 year lifetime.

The maximum cancer risk from this project is about 1 chance in 7 million (1.3×10^{-7}). This is compared against the cumulative cancer risk of about 1 chance in 1 million (1.1×10^{-6}) where glyphosate is applied 60 days each year over a 30-year career, assuming that the same workers would make these same treatments during that time period. As indicated above, the probability of this scenario occurring is low because most people change jobs during a 30-year career.

Under any of the alternatives, if the crew size were doubled to complete the project in half the time, exposures and cancer risk would be half.

Cancer Risk from Brown-and-Burn Operations

Based on the weight-of-evidence, the Environmental Protection Agency has chosen not to determine a cancer potency value for hexazinone, but to establish instead a reference dose (RfD) of 0.05 mg/kg/day (Rinde and Dykstra, 1992). Calculated doses to workers and members of the public were compared to the RfD to assess risk of cancer. (The closest estimate we can use for brown-and-burn operations, due to lack of dose information on brown-and-burns, is the dose estimate for public inhalation doses from burning firewood with herbicide residues (see R5-FEIS, page F-88)). **Any exposures would be very much lower than the RfD.** This coincides with information evident in a field study involving a prescribed burn following an application of Pronone 10G. The study found no residues of the herbicide in smoke samples (McMahon and Bush, 1991).

All of the cancer risk values calculated in this analysis are much less than 1 in 1 million except for the unlikely scenario where an individual sprays glyphosate for 60 days or more each year over a period of 30 years.

Several factors influencing risk could be modified to lower cancer risks for workers: reduce exposure by using protective clothing, reduce the amount of chemical used, reduce the number of days exposed each year, or reduce the number of years exposed during a lifetime. With this in mind, actual risks are probably lower than estimated in this document.

As stated above, based on the weight-of-evidence, EPA has chosen not to determine a cancer potency value for hexazinone, but to establish instead, a reference dose (RfD) of 0.05 mg/kg/day (Rinde and Dykstra 1992). Since a cancer potency value has not been established, the nonthreshold model can not be used to assess cancer risk. The RfD is an estimate of a daily exposure to the human population that is likely to be without appreciable risk of deleterious effects over a lifetime (EPA 1988). All potential doses to the public are well below the RfD. The only calculated dose that exceeds the RfD is the dose to backpack applicators (see Table 1-2). As discussed previously, use of protective clothing required by State regulation and mitigation measures for this project would reduce exposures well below the RfD. In addition, the use of the granular formulation proposed for this project would further reduce exposure. Therefore, the proposed use of hexazinone presents negligible risk of cancer to members of the public and to workers.

Synergistic Effects

Synergistic effects (multiplicative) are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive). For example, a mixture of 2,4-D and picloram has produced skin irritation in test animals while neither herbicide alone has been shown to cause this effect (USDA Forest Service 1989).

Instances of chemical combinations that cause synergistic effects are relatively rare (FEIS, page 4-112). In reviewing toxicological interactions of agricultural chemicals, Kociba and Mullison (1985) state that the scientific knowledge of toxicological effects indicates exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects. In assessing health risk associated with drinking water, Couch et al. (1983) reach a similar conclusion when they stated:

> "...in most cases we are concerned with small doses of one pollutant added to a sea of many pollutants. For those small doses a multiplicative effect is not expected."

EPA (1986) concludes, "There seems to be a consensus that for public health concerns regarding causative (toxic) agents, the additive model is more appropriate than any multiplicative model." Synergism generally has not been observed in toxicological tests involving combinations of commercial pesticides.

The herbicide mixtures proposed for this project have not shown synergistic effects in humans who have used them extensively in forestry and other agricultural applications. However, synergistic toxic effects of herbicide combinations, combinations of the herbicides with other pesticides such as insecticides or fertilizers, or combinations with naturally occurring chemicals in the environment are not normally studied. Based on the limited data available on pesticide combinations, it is possible, but quite unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis.

For those situations where more than one herbicide formulation is proposed for use in a single spray mixture, EPA recommends using the following hazard index (HI) as the additive model for assessing the risk from chemical mixtures:

$$HI = D_1/L_1 + D_2/L_2$$

where:

Dí is the dose of the íth chemical and
Lí is the level of safety (NOEL) for the chemical.

The inverse of this HI gives a MOS that can be compared with the 100-fold safety factor used in this analysis.

For example:

Assume a tank mix that will result in 1.5 lb./acre of glyphosate and 1 lb./acre of triclopyr being sprayed. From Tables 1-3 and 1-5, the dose to a worker applying the tank mix by backpack sprayer (highest exposure) is 0.044 mg/kg/day of glyphosate and 0.0081 mg/kg/day of triclopyr. Using the NOELs for reproductive effects (Table F-41):

$$HI = 0.044/10 + 0.0081/2.5 = 0.0076$$

The inverse of 0.0076 gives an MOS of about 130 for reproductive effects.

For systemic effects, HI = 0.044/31 + 0.0081/2.5 = 0.0047. The inverse of 0.0047 gives an MOS of about 210 for systemic effects.

Based on the MOS values calculated for this combination of herbicides, the risk of adverse effects on human health is low.

CUMULATIVE EFFECTS

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Cumulative doses from the same herbicide result from (1) additive doses resulting from various routes of exposure from this project and (2) additive doses if an individual is exposed to other herbicide treatments. The additive doses from various routes of exposure resulting from this project have already been considered in the exposure analysis (see for example Table 1-3).

Additional sources of exposure could include: 1) use of herbicides on adjacent private or public timber lands, 2) re-treatment of the same site in the same or following year, or 3) home use by a worker or member of the general public.

1) Use of Herbicides on Adjacent Private Timber Lands and National Forest

Information provided informally by a major private timber company with land within the project area and the Tuolumne County Agricultural Commissioner's records indicate that 1) applications of hexazinone, triclopyr and glyphosate have occurred over the last five years within the project area, 2) one application of glyphosate is planned within the next five years on 150 acres near Duckwall Mountain, and 3) one application of triclopyr is planned on 640 acres near the Quinn Ranch. There

are no applications planned on the proposed stands beyond what is listed in the description for the alternatives. Herbicides could be used on other areas within the general project area in the future.

There have been two applications of a tank mix of triclopyr and glyphosate on National Forest adjacent to the proposed project area. Called the Paper Cabin Release Project, these applications occurred on 895 acres in 1992 and 1993. No additional treatments are planned for this area at this time.

Since these herbicides persist in the environment for less than 12 months (VMFEIS, page 4-9), do not bioaccumulate, and are rapidly eliminated from the body (Dost 1991), and the applications planned on private property are for relatively small areas for one application only, additive herbicide doses from past or future treatments would not be significant.

2) Re-treatment of the Same Site in the Same Year

For this proposed project, there are some stands that would receive two separate treatments in the same year under Alternatives 1, 2 and 3. These stands would receive a spring treatment of glyphosate and a summer treatment of glyphosate/triclopyr. A worker or a member of the general public could be exposed to the additive dose of the new application plus any residual herbicide remaining on the site from the initial treatment. For example, if no degradation of a spring applied herbicide is assumed (an obvious over-exaggeration of the risk), the maximum exposure to a backpack applicator would be the dose for walking through the treated areas plus the dose from the second application (See Tables 1-2 through 1-5). Using the HI model described in the section on synergistic effects, the MOS values for systemic and reproductive effects were calculated for this possible herbicide combination:

Table 1-8 -Margins of Safety for expected herbicide combinations and spray sequences for workers using a backpack application.

Spring Application	Summer Application	Systemic MOS	Reproductive MOS
Glyphosate	Glyphosate/Triclopyr	210	130

Since most of the glyphosate would have degraded during the time between the first and second applications, and workers are required to wear protective equipment, the dose is expected to actually be lower.

3) Home Use by a Worker or Member of the Public

It was considered unlikely that any worker would apply herbicides on other sites (such as at home or on other contracts) on the same day, due to the remote location of the proposed project project and the ruggedness of the terrain.

If workers or members of the public use herbicides on private land (home, timber company property, farm), this use could result in doses equivalent to those estimated for this project if similar application rates are used. For example, if a person were to apply glyphosate around their home, the estimated dose could be as high as 0.044 mg/kg/day (Table 1-3). If this exposure were to occur on the same day as the proposed project, then this dose would be added to the estimated dose resulting from

exposure to the project and compared to the NOEL to determine the MOS. The lowest MOS values would occur from a home application of a glyphosate/triclopyr tank mix followed by a same-day project application of the same, which would give a systemic and reproductive MOS of 110 and 66 respectively. Protective clothing used at the job site or at home would reduce the dose and subsequently increase the MOS.

Hexazinone is currently not available for use by homeowners. It is approved for use in agriculture primarily for weed control in alfalfa. Although alfalfa may be produced in Mariposa or Tuolumne Counties, there are no known ranches close to the project area. In the unlikely event that a worker were to apply hexazinone at the rate of 3.5 1b/ac by backpack on this project, and then go home and apply 1.5 1b/ac (maximum label rate for alfalfa) to an alfalfa field using the same hand method, the cumulative dose could approach 0.14 mg/kg/day which gives a systemic and reproductive MOS of 71 and 360 respectively. This is considered highly unlikely because the worker would have to apply the herbicide for 16 hours a day while not using any protective equipment. The highest dose a forest user could receive from treating alfalfa and then entering the proposed project area would be 0.067 mg/kg/day which gives systemic and reproductive MOS values of 150 and 750 respectively, well above the benchmark MOS of 100. In all cases, the use of protective clothing at the job site or at home would reduce the dose.

Cumulative cancer risks to workers have been accounted for earlier in this risk assessment. Any increase in days exposed or in the rate of herbicide applied will increase the dose and the lifetime cancer risk. For example, a worker who is exposed to glyphosate as a result of this project has a lifetime cancer risk of 1 chance in 11 million or less (based on an application rate of 1.5 lbs/acre). If that same individual were to work on an additional project with the same application rate and for the same number of days (i.e., same exposure), then the cancer risk would double. The risk assessment also estimated cumulative cancer risks of 1.1 chances in 1 million if workers did the same type of work 60 days each year for a period of 30 years.

Cumulative cancer risks to the general public also have been accounted for earlier in this risk assessment. For each type of forest user (such as a hiker) we have assumed the individual is exposed each and every day they participate in that activity regardless of whether they are on public or private lands. The cumulative or lifetime cancer risks to the public were estimated to range from 1 chance in 4 million to less than 1 chance in 100 million.

For all instances, cumulative effects would be negligible with the exception of where individuals use herbicides at home on the same day of a previous exposure resulting from this proposed program. In the latter case the human health risks could double.

INERT INGREDIENTS

Table 1-9 lists the percentages of inert ingredients found in the herbicide formulations being considered for this project. The primary inert ingredient in Accord is water, kerosene in Garlon 4, ethanol in Velpar L, and clay in the Pronone formulation.

Table 1-9 Percentage of Inert Ingredients by Herbicide.

Chemical	Formulation	EPA Reg. #	% Inert
Glyphosate	Accord	524-326	58.5 (water)
Triclopyr	Garlon 4	464-554	38.4
Hexazinone	Pronone 10G	33560-21	90
Hexazinone	Velpar L	352-392	75

This risk assessment characterizes human health risks by comparing estimated herbicide doses to benchmark toxicity values derived from animal studies. These studies apply specifically to the active ingredients. Formulated products contain additional ingredients called inert ingredients which act as carriers for the active ingredients and facilitate the effective application of the herbicides. Also, the proposals identified in this analysis, include the use of other products to enhance performance. The R5-VMEIS scoping process identified a concern about the possible toxic properties of the inert ingredients and the full the formulated products.

The issue concerning inert ingredients and the toxicity of formulations is discussed in the R5-FEIS (pages 4-116 through 4-119). The approach used in the R5-FEIS and this site specific analysis to assess environmental effects of inert ingredients and full formulations has been to: (1) compare acute toxicity data between the formulated products (including inert ingredients) and their active ingredients; (2) disclose whether or not the formulated products have undergone chronic toxicity testing; and (3) identify, with the help of EPA and the chemical companies, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients. Researchers have studied the relationships between acute and chronic toxicity and while the biological end-points are different, relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise 1984). The court in *NCAP v. Lyng*, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decisionmaker to make a reasoned decision. In *SRCC v. Robertson*, Civ. No. S-91-217 (E.D. Cal., June 12, 1992) the district court upheld the adequacy of the R-5 FEIS methodology for disclosure of inert ingredients and additives.

The EPA has categorized approximately 1200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of toxicological concern (FEIS, 4-416; Fed. Reg. 54:48314-16). List 3 includes substances such as soaps and detergents. List 4 contains inerts generally recognized as safe such as corn oil, honey or water. Use of formulations containing inert ingredients on List 3 and 4 is preferred on vegetation management projects under current Forest Service policy.

Since most information about inert ingredients is classified as "Confidential Business Information" the Forest Service asked EPA to review the formulations and tell us whether they contained inert ingredients of toxicological concern (FEIS, 4-117). The Forest Service also asked for and received information from the companies that produce the herbicides and spray additives.

In order to obtain the confidential information for our analysis, the Forest Service promised the chemical companies that the disclosure of the information would be in a way that would maintain the confidentiality of herbicide formulations and protect trade secrets. Our approach for disclosure is to list all inert ingredients of the herbicides and all ingredients of spray additives currently being considered for use in the Region without associating these ingredients with specific products (see Table 1-10).

To date, two chemicals on EPA's inert ingredient List 2 have been identified in the Garlon 4 formulation of triclopyr: kerosene and 2-butoxyethanol (EGBE) (Dow Chemical USA, 1988). Kerosene is used as an inert ingredient in the formulated product and EGBE is a manufacturing impurity of the triclopyr ester used in Garlon 4.

A risk assessment for kerosene was completed for the R-5 FEIS (page F-77). Kerosene is classified as a very slightly toxic mixture based on an acute oral LD_{50} of 28,000 mg/kg for rats. It is a skin irritant, but has not been shown to be mutagenic or to cause cancer (R-5 FEIS page 4-118). The addition of kerosene in the Garlon 4 herbicide formulation does not significantly increase the risk to human health over the risk identified for the active ingredient triclopyr.

The Forest Service also evaluated the health risks associated with the impurity EGBE present in the Garlon 4 herbicide formulation (Borrecco and Neisess, 1991). EGBE is classified as a moderately toxic compound based on an acute oral $LD_{50}$for rats of 470 mg/kg. The primary toxic effect of EGBE is to make the red blood cells more fragile. This effect has been seen primarily in rodents at excessive doses. Studies with human cells suggest that humans are not as susceptible as rodents. The health effects data indicate that EGBE found in Garlon 4 herbicide does not represent an acute, chronic, or reproductive hazard to humans. EGBE is not a carcinogen. The risk assessment shows that the addition of EGBE found in Garlon 4 does not substantially increase the risk to human health over the risk identified for the active ingredient triclopyr. The "Risk Assessment for the Impurities 2-butoxyethanol and 1,4-dioxane Found in Garlon 4 and Roundup Herbicide Formulations" (Borrecco and Neisess, 1991) is on file at the Regional Office, Forest Supervisor's Office, and Groveland Ranger District Office. It is incorporated by reference into this risk assessment in accordance with 40 CFR 1502.21.

Current Forest Service policy is to permit the use of formulations containing inert ingredients that are on the EPA List 3 and 4. Formulations containing List 1 or 2 ingredients are used only when other formulations, with List 1 or 2 ingredients, is available. In addition, a health risk assessment must be completed too evaluate risks. Our analysis shows that the addition of 2-butoxy-1-ethanol does not increase the risks in a substantial way.]

The use of the surfactants R-11 and MOR-ACT and/or colorants was included in the site-specific risk assessment for this project. None of the ingredients in these products are on EPA List 1 or 2. Information used in the assessment was obtained from EPA and the manufacturers. Based on the chemical nature of the ingredients, only very slight toxicity is expected. The use of additives in the formulations would result in almost no risk to the health and safety of the workers or public.

Comparison of acute toxicity (LD_{50} values) data between the formulated products (including inerts) and their active ingredients alone shows that the formulated products are generally less toxic that their active ingredients (R-5 FEIS, pages 4-117 to 4-119; Monsanto Company 1987; USDA Forest Service 1984). While these formulated products have not undergone chronic toxicity testing like their active ingredients; the acute toxicity comparisons, the EPA review, and our examination of toxicity information on the inert ingredients in each product leads us to conclude that the inert ingredients in the Accord, Pronone 10G, Velpar L, and Garlon 4 formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients. Health risks from the inert ingredients and the full formulations of the proposed treatments are low.

Table 1-10 includes all inert ingredients and impurities identified by EPA and the chemical companies in the herbicide formulations proposed and all ingredients in the adjuvants commonly used in the Region.

Table 1-10 Identified Inert Ingredients

Inert Ingredient	Toxicity Rating
1,4 dioxane	List 1 inert; LD_{50} = 4200 mg/kg
Kerosene	List 2 inert; LD_{50} > 28,000 mg/kg
2-butoxyethanol	List 2 inert; LD_{50} = 470 mg/kg; testicular atrophy after repeated oral dosing
Polyethoxylated tallow amine	List 3 inert; oral LD_{50} = 1,200 mg/kg, Dermal LD_{50} > 1,260 mg/kg
Octyl phenoxy pholyethoxyethanol	List 3; oral LD_{50} > 5,000 mg/kg, moderate skin and eye irritant
Polyol fatty acid esters and derivates thereof	List 3 inert
Amine salts of organic acids	List 3 inert; slight skin and eye irritant
Aryl sulfonate derivative	List 3 inert
a-(p-nonylphenyl)-2-hydroxypoly oxyethylene	List 3 inert; slight irritant
Poly (methylene-p-nonyl phenoxy) polyoxypropylene propanol	List 3 inert; slight irritant
Water	List 4 inert
Clay carrier	List 4 inert
Carbohydrates	List 4 inert
Aliphatic alcohol	List 4 inert; moderate eye irritant
Aliphatic carboxylic acid	List 4 inert
Compounded silcone	List 4 inert
Silicone	List 4 inert
Non-ionic emulisifiers	List 4 inert
Aromatic acid	List 4 inert
Alphatic polycarboxylate	List 4 inert
Calcium salt	List 4 inert
Potassium salt	List 4 inert
Nonionic block polymer	Oral LD_{50} 2100 mg/kg, not on EPA List 1 or 2
Sodium dioctyl sulfosuccinate	Oral LD_{50} 2200 mg/kg, not on EPA List 1 or 2
Hydroxypropyl methylcellulose	Oral LD_{50} 10,000 mg/kg, not on EPA List 1 or 2
Sodium aluminosilicate	Oral LD_{50} > 2000 mg/kg, not on EPA List 1 or 2
Ethoxylated octyphenol	LD_{50} = 2,000 mg/kg; not on EPA list 1 or 2
Paraffinic/naphthenic solvent	LD_{50} = 40,000 mg/kg; not on EPA list 1 or 2
Non-phytotoxic paraffin base petroleum oil	Oral LD_{50} > 5,000 mg/kg, mild skin and eye irritant, not on EPA list 1 or 2
Aromatic and aliphatic petroleum distillates	LD_{50} > 5,000 mg/kg, mild eye and skin irritant
Ethanol	Very slight toxic, not on list 1 or 2; LD_{50} = 13,700 mg/kg

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Attachment 1

Paper Environmental Impact Statement
Aerial Spray Modeling

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April 1993

Computer modeling was done in order to evaluate the buffer needed to protect sensitive areas from off targeted drift of aerially applied herbicides. Details on the computer program follow. Over the last 20 years the Forest Service, in cooperation with other government agencies, has developed two models for deposition of aerial pesticides. They predict the behavior of the spray materiel as it is subject to aircraft wake, atmospheric effects, vegetation canopy, and deposition on the ground. These models have been validated by field test data and the individual engineering approximations have been validated by laboratory experiments. These models have been combined into a one computer model referred to as FSCBG (USDA Forest Service Cramer, Barry, Grim). FSCBG can be used to find optimum equipment mix and application rates. It can model exactly where the spray material is deposited. There are several limitations that are pertinent. The program can not model dispersion on uneven topography. Projections may be less reliable outside of the data set limits the model was developed with.

FSCBG 4.05 was used with actual equipment types to model granular hexazinone, (Pronone 10G) application. The hexazinone is impregnated into dry clay granules. The dried granules are not effected by evaporation as they fall. This factor reduces the importance of temperature and humidity on modeling. Results are displayed in the charts below. The upper limit to operations is 6 miles per hour per the R5-EIS. Modeling of 10 mph allows for unexpected gusting. Flight lines are critical to modeling as they represent the points at which the aircraft release the spray material. Remote receptors were modeled in two situations. The first situation modeled wind parallel to the flight lines with receptors directly down wind from the flight line. The second situation was modeled with wind parallel to the flight line and receptor grid down wind.

Wind Direction Parallel to the Flight Line

Distance from flight line	5 miles/hour lbs/acre	10 miles/hour lbs/acre
25 feet	*	21.06
50 feet	0	*
75 feet	0	*
100 feet	0	0

* Detection limit for soil sampling is 8.83 x10-4 lbs/acre therefore values lower than that are undetectable.

Wind Direction Perpendicular to the Flight Line

Distance from flight line	5 miles/hour lbs/acre	10 miles/hour lbs/acre
25 feet	1.74	0.072
50 feet	0	2.89
75 feet	0	0.0069
100 feet	0	*

* Detection limit for soil sampling is 8.83 x10-4 lbs/acre therefore values lower than that are undetectable.

APPENDIX 2

SURFACE AND GROUND WATER QUALITY MONITORING PROTOCOL FOR HERBICIDE PROJECTS

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INTRODUCTION

Current Pacific Southwest Region vegetation management policy for reforestation allows for the use of herbicides on National Forest land in California. The Final Environmental Impact Statement (FEIS) for Vegetation Management for Reforestation (USDA, 1988) contains monitoring and mitigation requirements for herbicide projects to minimize potential impacts to water quality. For each project, site-specific analysis is required to determine the need for and degree of water quality and cumulative effects monitoring. The FEIS also requires monitoring of herbicide residues in ground and surface water to identify patterns of herbicide persistence and mobility at sensitive sites.

The purpose of this report is to provide a protocol for developing site-specific water quality monitoring plans necessary to meet the requirements in the FEIS. Additional monitoring or protection measures may be required on some projects as determined by a site-specific analysis. This report incorporates mitigation measures from the FEIS, Best Management Practices (BMP's) (USDA, 1987), information from the R-5 Monitoring Workshop held in Placerville in April, 1990 and information from selected hydrologists and geologists in Region 5.

The organization of this report will follow the outline of a site-specific water quality monitoring plan and will discuss the sections of such a plan. Those sections are as follows:

1. Statement of objectives
2. Beneficial Use Risk Assessment
3. General Water Quality Protection Measures

4. Monitoring Plan
5. Project Evaluation and Reporting

1. *STATEMENT OF OBJECTIVES*

The objectives of a Water Quality Monitoring Plan are to: 1) protect all beneficial uses of water by meeting state and federal water quality standards during both herbicide application and in subsequent peak runoff periods; and 2) avoid or minimize adverse cumulative watershed effects due to herbicide use.

The Forest Service is required by the Clean Water Act (P.L. 92-500, as amended, 33 U.S.C. Section 1251 et. seq.) and Executive Order 12088 to comply with Federal, State and local government water quality goals, objectives and procedures. State water quality standards are set by the California Regional Water Quality Control Boards and are described in the various basin plans issued by those Boards.

Two actions are required to achieve the above objectives. The first and foremost action is to *prevent* unplanned herbicide introduction to streams, rivers, standing water and groundwater aquifers to the maximum extent possible. This action addresses the potential for contamination during application due to mis-application or accidental releases. Prevention is accomplished through implementation of BMP's and the mitigation measures listed in the FEIS.

The second action is to *detect* any project related contamination to determine if water quality standards have been met and to allow for appropriate action to be taken to protect beneficial uses in the event of an introduction. This is accomplished by "Early Warning" monitoring during application and by post-application sampling of surface and ground water and streambed sediments to detect off-site migration and persistence of contamination.

Together prevention and detection are intended to eliminate or greatly reduce the risk and quantity of unplanned introduction of herbicides to water and to determine how successful the preventive measures have been.

2. *BENEFICIAL USE RISK ASSESSMENT*

Beneficial Use Risk Assessment is a process used to determine measures necessary to protect downstream beneficial uses of water and to evaluate the need for and intensity of water quality monitoring. This assessment is based upon the beneficial uses in the affected watersheds and the specifics of the treatment such as herbicide to be used, application rate, timing and method.

A "beneficial use" is a State recognized valid use of water including, but not limited to: domestic, municipal, and agricultural supply; recreation; and preservation and enhancement of fish, wildlife and other aquatic resources. Beneficial use of groundwater occurs at artificial and natural groundwater discharge points such as horizontal and vertical wells, springs, seeps and baseflow discharge to streams. Sources of information on location of beneficial uses are maps, water rights files, geologic resources inventories, facilities records, range allotments, stream surveys, and recreation plans.

Location of the treatment unit in relation to the water body helps determine protection and monitoring measures needed. Treatment units in the upper reaches of a watershed or near ridgetops pose less risk than those closer to large streams. Topography also plays a role as the chance of chemical residue moving off-site either in solution or attached to soil particles increases as slope steepens. Streams, including ephemerals,

flowing through treatment units may require measures such as designated stream crossings in addition to unsprayed buffer zones.

The nature of aquifers and local groundwater conditions influence the potential for groundwater contamination. For example, shallow aquifers in weathered granular material overlying granitic bedrock are more likely to be contaminated than are fractured rock aquifers deep in granitic bedrock. Also, the recharge area for an identified aquifer may be in a watershed other than where the discharge point is located.

Chemical characteristics, such as persistence and mobility, influence monitoring location and frequency. A chemical such as hexazinone, which is water soluble, highly mobile and has a long persistence time, has a greater potential for contaminating surface and ground water than a chemical like glyphosate which binds to soil particles and degrades more rapidly. Hexazinone, therefore, would require protection measures and monitoring different than that for glyphosate. Table 4-3 in the FEIS contains information on the mobility and persistence of a number of herbicides in soil and water.

Climatic regime of the treatment site in combination with chemical characteristics affect monitoring strategies. For a highly leachable chemical like hexazinone, the timing of potential contamination, and thus sampling, differs in units in a snow dominated zone than in those in a rain or rain-on-snow dominated zone. Movement of sediment-transported chemicals such as glyphosate is a concern in areas where overland flow and sediment movement during intense summer thunderstorms is likely.

Application method and herbicide form influence the potential for drift, which in turn, affects the amount and timing of monitoring required. Aerial operations have a greater potential for chemical movement off-site through drift than do ground application techniques, and thus would require more intensive monitoring during application. Granular or pelletized herbicides pose less risk of drift than do liquid forms.

Time of application determines the timing of monitoring and water sampling. Application of glyphosate in May poses different concerns than application of hexazinone in September. Extra protection measures may be necessary when the herbicide treatment is simultaneous with high beneficial use periods.

The Beneficial Use Risk Assessment can be summarized in a table listing the units and protection and monitoring measures applied to each unit. A short narrative describing any additional or special measures necessary to protect water quality, or why none are needed, should be included.

3. *GENERAL WATER QUALITY PROTECTION MEASURES*

This section of the Water Quality Monitoring Plan lists the measures that will be implemented to prevent or minimize water contamination during and after herbicide application. Water contamination during application is caused by spills, herbicide drift and contaminated equipment and people coming in contact with water. Contamination subsequent to application results from a combination of chemical persistence, mobility and weather conditions especially the amount and timing of precipitation.

The monitoring plan will include the following project-wide mitigation measures as well as any additional protection measures for sensitive areas determined by the Beneficial Use Risk Assessment:

1. Strictly follow all EPA and State-approved herbicide labels.

2. Mixing and loading will be done in areas where accidental spills will not contaminate streams or other water.

Herbicides will be transported in original containers along designated routes. Mixing sites will be predetermined by the COR and should be as far from water and on ground as level as possible. Spill contingency material will be on hand at all times.

Water sources will be only at sites designated by the COR . Only "clean" equipment will be used to draw water.

3. Spray tanks will not be washed in or near streams, rivers, or lakes. Herbicide containers will be disposed of in accordance with State and Federal regulations. Containers will be triple rinsed with rinse water applied to the project site.

4. Include spill cleanup procedures in all project plans.

5. Carefully monitor weather conditions (windspeed and direction, precipitation, precipitation probability, temperature, temperature inversions, atmospheric stability, and humidity) before and during herbicide applications to prevent drift, volatilization, leaching or surface runoff of herbicides.

6. Buffer strip locations and widths will be determined from site-specific analysis. Minimum buffer width for aerial applications will be 100 feet.

   Buffer widths for ground applications were not specified in the FEIS. The ID team should decide on appropriate buffer widths.
   Springs and wet areas within treatment units will be evaluated by a hydrologist or geologist prior to spraying to determine protection requirements.

   Buffer Zones should be identified prior to spraying and off-limits to anyone involved in the spraying.

7. Use low-volatility formulations and adjust equipment to reduce risk of drift.

8. For aerial applications on sites requiring multiple swaths, turn off spray at the end of spraying a swath and during turns prior to starting another swath. Initial spray swaths along buffer strips or other areas to be protected will be made parallel to these areas and when the wind is blowing away from the area.

9. To minimize drift and volatilization, aerial spraying will be prohibited when any of the following conditions exist on the spray area:

   -wind velocity greater than 6 miles per hour

   -raining or rain imminent

   -foggy weather

   -low relative humidity (less than 30%) and temperature exceeds 85 degrees F (for water-based sprays only)

   -temperature inversions that could lead to offsite movement of the spray.

10. A colorant may be added to the herbicide prior to spraying or spray cards can be used to aid in evaluating ground coverage and drift. Flourescent dye may be substituted when spraying

near water because it can be detected in water by flourometric measurements when early warning monitoring is necessary.

4. *MONITORING PLAN*

The purpose of monitoring is to detect where, when and how much herbicide may have entered surface water. Monitoring of water quality and cumulative watershed effects is required by the FEIS and BMP 5.10 "Pesticide Application Monitoring and Evaluation." This section of the Water Quality Monitoring Plan describes what monitoring is required for the project and where, when and how it will be accomplished.

Selection of monitoring requirements is based on the risks and hazards of herbicide entering water determined in the Beneficial Use Risk Assessment. In general, waters that provide high-value beneficial uses that have the greatest risk of being damaged by contamination should be considered sensitive areas and receive highest priority and intensity of monitoring effort. Beneficial uses include municipal supply, domestic supply, fisheries, waters used for contact recreation, irrigation supply and stock water supply. The following is a discussion of the minimum monitoring effort required by the FEIS. Additional sampling may be warranted as determined by site-specific analysis in project planning.

Monitoring can be divided into pre-treatment, treatment and post-treatment monitoring.

Pre-Treatment Monitoring

Pre-application samples of surface water, groundwater and streambed sediment should be obtained and analyzed to determine background herbicide concentrations. This is especially important in watersheds which include private timber lands where herbicides have been used recently. These samples can be obtained in the days just prior to the herbicide application. In locations where "doping" could be a concern, basic water chemistry can be analyzed to obtain a "fingerprint" of the water.

Treatment Monitoring

This is monitoring during herbicide application. It usually consists of on-site observations to determine if water protection measures are being implemented, and may consist of "early warning" monitoring to identify possible hazardous conditions to nearby beneficial users. Early warning monitoring can also detect where adjustments in application operations are needed to protect beneficial uses.

Early warning monitering consists of direct visual observation of the herbicide application operation. The observer will ensure the functional integrity of streamside buffer strips. Spray cards or a colorant added to the herbicide mix can be used to aid in detecting herbicide drift. Spray cards are specially treated paper which changes color when in contact with herbicide. These cards can be placed in the streamside buffer strip and stream channel prior to spraying. If any of the cards become discolored during spray operations, or the observer sees drift entering water, spray operations should be stopped and appropriate corrective measures taken.

In situations such as aerial spraying where direct entry of herbicides into water is a possibility, fluorometry or immuno-assay techniques may be used along with visual monitoring for early warning during spray applications. In fluorometry, herbicide concentration in water is indirectly measured using a dye tracer. The amount of herbicide is assumed to be proportional to the dye concentration in the water. Presence of dye in a stream sample indicates that the operation needs to be reevaluated. Protection measures should be assessed and changed if necessary before herbicide application can proceed.

Immuno-assay evaluation is a quick on-site test which determines absence or presence but not necessarily an accurate concentration or duration of herbicide in water; reevaluation of application procedures is needed if the test shows presence of herbicide in water.

When ground based spraying methods such as backpack sprayers or tractor boom mounted sprayers are used, the potential for direct herbicide introduction to water from drift is low. Although fluorometry can be used in these situations, direct visual observation is more efficient for early warning monitoring.

Contract language should be such that operations can be stopped by the COR if early warning monitoring indicates herbicide has entered water. Water samples should be taken for laboratory or on-site immuno-assay analysis to determine the magnitude of herbicide contamination. The project spill plan will contain notification procedures. The responsible line officer should decide the level of contamination that triggers notification of downstream beneficial uses. The California Regional Water Quality Control Board should be consulted for guidance on determining that level.

Post-Treatment Monitoring

Post-application monitoring is necessary to determine off-site movement and persistence of herbicides. Laboratory analysis of surface water and groundwater samples track herbicide movement in water. Streambed sediment samples are analyzed to monitor herbicide accumulation. These samples will provide data to determine compliance with water quality standards and to assess effectiveness of protection measures. Considerations in sampling include sampling station location, sampling frequency and sample handling and analysis.

Sampling Station Location

Several factors are involved in selection of monitoring stations. Sites should be selected where suspected contamination is most likely.

Surface Water and Sediment Sampling. Surface water sampling stations can be chosen to monitor groups of treatment units rather than each individual unit because entry of herbicide residue into surface water following application would come from surface runoff during storms, groundwater inflow or erosion.

Sampling stations should be located immediately below the treated site(s) to detect herbicide concentration with minimal dilution. Depending on local conditions, sampling may also be conducted further downstream in the project area, at outlets of watersheds exiting the project area and further downstream if necessary.

Sampling stations should have good access, especially during storms, and be close together if possible, to reduce travel time between sites. Stations should be marked with stakes, flagging or tags and referenced when they are established in the field.

Selected sample locations should have uniform flow and good mixing conditions. Travel time between the sample location and the nearest unit will be determined by using a dye tracer or a float. Streambed sediments can be obtained from depositional areas near water sampling points.

Groundwater Sampling. In selecting groundwater sampling stations, a geologist should be consulted to ensure placement of wells in locations and to depths where herbicide contaminated groundwater would migrate. The permeability of the aquifer should be estimated and the rate of groundwater movement from the treated unit and monitoring well determined. Because groundwater may contribute to stream baseflow, some monitoring sites should be selected to determine whether contamination detected in surface water is partially or wholly derived from baseflow.

Monitoring of groundwater can be accomplished by installing monitoring wells or sampling natural discharge points like springs and seeps. A monitoring well usually consists of a hole augured in soil or drilled in rock, a casing of PVC pipe or other material which is not chemically reactive with the herbicide, and a slotted pipe placed at the depth where groundwater is expected to be intercepted. If more than one depth is to be sampled at a location, additional wells will be needed to sample the other depths. A locking cap should be placed on the wells to prevent contamination by outside agents. Wells should by marked with flagging or tall stakes and the well location should be plotted on the project map.

Sampling Frequency

Surface Water Sampling. Following herbicide applications, surface water samples will be taken during storm runoff periods to determine the amount of herbicide which may have entered the water through surface runoff. Selection of **minimum** sampling frequency is based upon chemical mobility, persistence and the time of application. If herbicide is detected in any of these samples, **additional** samples will be necessary to evaluate the magnitude and persistence of contamination. Again, the responsible line officer, with guidance from the California Regional Water Quality Control Board, should decide the level of contamination that triggers additional sampling and notification of beneficial users. The **minimum** amount of water sampling should be as follows:

For applications of low mobility, low persistence chemicals such as glyphosate and triclopyr, one sample will be taken during the rising limb of the hydrograph during the first significant runoff producing storm occurring after herbicide application. A "significant storm" needs to be defined by the project hydrologist or ID Team. For spring applications, this storm may be a summer thunderstorm or may not occur until fall. The sample will be taken at a time when the herbicide would be expected to pass the sampling station based on calculated or measured travel time from nearest treated unit.

For applications of high mobility, high persistence chemicals like hexazinone, one sample will be taken during the first significant runoff producing storm following treatment and one sample during the peak snowmelt runoff the following spring. For spring applications, the first storm could be a summer thunderstorm. For fall applications in the rain zone, it would be the first fall storm following application. For fall applications in the snow zone, if no rain falls on the treated unit before it snows, the first sample will be during snowmelt runoff. In units that lie within the rain-on-snow zone, a sample should be taken during one of these events. Again, these samples would be taken on the rising limb of the hydrograph at a time when the herbicide would be expected to pass the sampling station.

Sensitive areas treated with hexazinone or similar chemicals require more intensive sampling such as a series of hourly samples for 24 hours during the first storm. A peak flow sample and a composite of the rest should be analyzed.

Groundwater Sampling. Post-application groundwater sampling is only necessary where water soluble, highly leachable chemicals such as hexazinone are used. The frequency and timing of sampling will depend on the permeability of the aquifer and the climatic events affecting the groundwater flow regime. A sample should be collected following a storm or during a snowmelt period after application. The sample should be representative of when it is expected that herbicide would pass the sample point. Several samples should be collected over a day or couple of days and composited.

Streambed Sediments Sampling. Streambed sediments will be sampled to monitor cumulative watershed effects. Streambed deposits can act as a chemical sink as sediment particles contaminated by herbicide residue enter the stream system and settle out during low flow periods or as dissolved or suspended herbicides become adsorbed or absorbed by sediments. This herbicide residue can go undetected by sampling water above the streambed.

Streambed sediments will be sampled at surface water sampling stations prior to herbicide application. Samples of fresh streambed deposits will be taken the first fall and spring following herbicide application. Ideally these samples will be taken after a period of low stream flow when sediment is deposited.

Sample Collection and Analysis

Samples will be taken by personnel not otherwise involved in the herbicide application operation. Extreme care must be taken to prevent sample contamination. The collector must not have any herbicide or other contaminant on his/her hands or clothing. Sample containers must not be transported or stored with herbicides.

Surface Water Sampling. Instantaneous samples should be as representative as possible of the total volume of water passing the monitoring station at any moment. Samples should be collected without stirring up bottom sediments or introducing surface debris into the water. For small streams, a grab sample should be taken at the lower end of a straight, narrow length of channel carrying a steady flow of water. On larger streams, the samples should be taken near the center of the channel at a depth of 2-4 inches in a well-mixed cross-section, such as a drop in the channel. Do not sample in slow-moving pools or where there is a noticeable eddy effect. The container should be slowly lowered into the main flow of the stream. The bottle opening should be facing upstream so that water does not contact the sampler's hands or boots before entering the bottle. Sufficient volume should be collected to allow for adequate sample analysis and permit running a duplicate. Generally, one liter of water is required per sample for analysis.

Automatic samplers can be used to obtain stage samples without an operator present. Automatic samplers range from simple devices which operate on a siphoning principle to sophisticated and complex devices which can be set to take samples at predetermined intervals.

Groundwater Sampling. Groundwater sampling from monitoring wells should employ a bottom bailer or syringe bailer capable of drawing from the bottom of the well. The bailer should be stainless steel or teflon coated. To avoid cross-contamination of monitoring wells and samplers, a sampler should be dedicated to each well or cleaned between sampling of different wells according to procedures appropriate to the herbicide being used. Monitoring wells should be purged prior to collecting the sample. Typical sample size is a 40 ml extraction.

Sample collection from springs or seeps involves direct collection of water from the surface discharge. Sampling precautions and amounts are the same as those for surface water.

Streambed Sediment Sampling. Streambed sediment samples can be collected using sophisticated core sampling devices or by a simple scoop of sediments. At least 200 grams should be collected to allow for one analysis and a duplicate.
Samples can be composited to reduce the cost of laboratory analysis. A composite sample is a combination of equal parts of two to five samples. It is most commonly used for single stations and permits one sample to represent a time interval or a stream cross-section where uniform mixing is doubtful. Both water and sediment samples can be composited, but not together.

Generally, sample containers should be amber glass bottles with teflon lids. Sample bottles should be available from the lab doing the analysis. In the field, samples should be stored in a cooler of ice. Some samples such as glyphosate may need to be frozen. Check with the lab for sample handling procedures. Samples should be transported to the lab preferably within two days from time of collection. Duplicate samples not analyzed must be stored in a cool, dry location, completely removed from herbicides or other chemicals for no longer than 6 months. A half-pint sample of a batch of spray formulation should be taken and kept until analysis reports are complete.

Each sample must be clearly identified and all pertinent information correctly and completely entered into the station record and recorded on a tag or label securely attached to the container. Identification information on the sample and form must be the same. Identification tags must include: 1) station identification 2) date and time of sample collection, 3) name of person collecting the sample and 4) type of sample. Identification tags and sample forms should be checked for accuracy and completeness prior to submission for analysis.

Analysis of samples should be coordinated through the forest or project hydrologist. A state certified lab will be used to do the analysis. Obtain QC/QA information from the lab. Spiked samples and blanks should be sent to the lab along with the water samples for quality control. Labs will require chain of custody papers with all samples. It will take approximately 2 to 3 weeks to receive results from the lab.

Selection of a lab(s) will depend on proximity of the lab to the forest. For an example of the costs for lab analysis of water samples, the following information is provided for two labs in the Sacramento area:

TABLE A2-1: COST FOR LAB ANALYSIS OF WATER SAMPLES

Eureka Lab: Anlab:

detection detection
Chemical $/sample limit $/sample limit

Glyphosate 150 1 ppb 175 5 ppb

Hexazinone 150 1 ppb 95 1 ppb

Triclopyr 150 0.05 ppb 95 0.1 ppb

Eureka Laboratories, Inc.
3401 La Grande Blvd.
Sacramento, CA 95823
(916) 381-7953

AnLab, Analytical Laboratories
1914 S Street
Sacramento, CA 95814
(916) 447-2946

5. *PROJECT EVALUATION AND REPORTING*

This section of the Water Quality Monitoring Plan lists the project records that will be kept, and how the project will be evaluated and reported.

A record consisting of maps, field notes, correspondence with lab and sample point history will be filed with the forest hydrologist. The maps should show treatment units beneficial uses and monitoring stations. Field notes should include weather conditions -- precipitation, temperature and wind, two days before, during and after application. Correspondence with the lab should include the current instructions regarding handling procedures and the results of sample analysis. The sample point history will include the complete record of the sample station in addition to the following:

a. Type of chemical, formulation and manufacturer.
b. Application formula and rate.
c. Method of application.

d. Weather conditions during spraying and water monitoring.
e. Any unusual occurrence that might affect water analysis results.
f. Description of treatment units within drainage area of sample point.
g. Record of correspondence with organizations, groups and individuals concerning results of the water monitoring and water quality.

Reports regarding spray progress in relation to water quality protection measures will be made to the project manager as often as necessary during herbicide application. The purpose of these reports will be to determine if any changes in preventive measures are needed.

Periodic monitoring results should be provided to the California Central Valley Regional Water Quality Control Board during herbicide application for their determination of compliance with the pesticide water quality objective in the Water Quality Control Plan (Basin Plan), and for determination of compliance with water quality anti-degradation policies of the federal government (40 CFR Ch. 1, Section 131.12) and the State of California (State Water Resources Control Board Resolution 68-16).

At the completion of the project, or more frequently, evaluation of the effectiveness of protective measures will be based on visual observations of target vegetation once it has had a chance to die and the results of water and sediment sampling. A summary report will be prepared that will contain analysis results and a narrative of the effectiveness of the BMP's implemented to protect water quality. This report will be kept on file with the forest or project hydrologist. Copies will be sent to the appropriate Forest Service officials, to the California Central Valley Regional Water Quality Control Board and to local recipients such as the County Agricultural Commissioner, interested publics and the media.

SUMMARY:

This report provides a protocol for developing site-specific Water Quality Monitoring Plans for herbicide applications to meet the requirements in the FEIS and BMP's. The following is a list of references that will provide additional information on herbicides and sampling techniques:

USDA, Forest Service (Pacific Southwest Region). 1988. Final Environmental Impact Statement. Vegetation Management for Reforestation.

USDA, Forest Service (Pacific Southwest Region). 1987. Soil and Water Conservation Handbook. R5 FSH 2509.22

USDA, Forest Service (Southern Region). Final Environmental Impact Statement. Vegetation Management in the Coastal Plain/Piedmont.

USDA, Forest Service (Pacific Northwest Region) Water Quality Monitoring Guide for Pesticide Detection. R6-WS-040-1980

Herbicide Handbook of the Weed Society of America - 6th Edition. 1989.

Various chapters of Water-Resources Investigations of the United States Geological Survey.

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PROTOCOLS FOR MONITORING SOILS FOR HERBICIDE RESIDUE

1. OBJECTIVE

As discussed in the Regional F.E.I.S for Vegetation Management, monitoring for herbicide persistence, accumulation and mobility, and key soil quality characteristics will be included in site specific analysis. Soil monitoring plans to meet the intent of the Regional F.E.I.S and provide feedback on project implementation are described here.

The objective of soil monitoring is to assess the cumulative effect of herbicides on soils (whether for not herbicides persist and accumulate) as specified in the R-5 Vegetation Management EIS and ROD. Therefore, focus is on the upper part of the A horizon, where herbicides would tend to accumulate. If not found in this soil layer, the assumption is that herbicides have been degraded, been washed off-site, or have been leached deep into the subsoil. In the latter two cases persistent herbicides would be detected by surface or ground water monitoring.

HERBICIDE MONITORING

1. PROJECT RISK ASSESSMENT

The monitoring protocols described here assume that a risk assessment or suitability analysis has been conducted on each area proposed for treatment with herbicides. The assumption is that unsuitable or high risk sites have been eliminated from consideration, will have special mitigation measures applied, or will require special monitoring above and beyond these standard protocols.

The risk of herbicide migration off-site is affected by soil and site factors that affect the capacity of the soil to absorb herbicides or factors that affect potential for runoff and erosion. Examples include soil type, texture, organic matter, effective soil cover, compaction, amount of area in skid roads and landings, integration of skid road pattern (with respect to concentration of runoff), presence of active erosion or gullies, amount of rock outcrop or surface coarse fragment, etc.

2. PURPOSE AND TYPES OF SAMPLING

Two types of soil sampling will be conducted, each with a different objective. They are: (1) where required by herbicide label, sampling to determine organic matter content and soil texture to calculate application rate of soil-activated herbicides, (2) pre- and post-treatment sampling to detect herbicide residues in the soil.

Based on the results of the MiWok Paper Cabin Release and the Groveland Conifer Release projects, which showed no detectable level of glyphosate herbicides present in soil following treatment on similar soils as the Paper Cabin Reforestation Project Area in 1992 and 1993, no soil monitoring for glyphosate is planned in this project.

3. SAMPLE SITE SELECTION AND SAMPLE POINT LOCATION

A. Sampling for organic matter and texture.

All treatment areas that have passed the suitability screening will be sampled. Sampling could be limited to one sample point per soil series or soil landscape. Sample points will be selected as follows:

Arbitrarily locate a point near the center of the treatment area; generate a random azimuth and sample along two 100 foot transects radiating from the center point, one along the azimuth reading, and one 135 degrees from the azimuth reading.

Collect ten soil samples from each 100 foot transect, and composite all 20 samples into one soil sample for analysis. Sampling depth will be at 2 inches.

B. Sampling for Herbicide Residues in Soils and Humus.

Within this project area treatment units will be grouped by similar soils for each herbicide treatment type. One sampling unit will be randomly selected from each group of treatment units. On the selected units, the components of monitoring described in the Regional FEIS will be applied.

On each unit selected for sampling, soil and humus (if present) samples will be collected at 20 points in the unit as follows:

Arbitrarily locate a point near the center of the selected treatment area; generate a random azimuth and sample along two 100 foot transects radiating from the center point, one along the azimuth reading, and one 135 degrees from the azimuth reading.

Collect ten soil samples from each 100 foot transect, and composite all 20 samples into one soil sample for analysis. Sampling depth will be at 2 inches.

4. SAMPLE COLLECTION AND STORAGE

A. Soil and Humus Sampling

At each sampling point along the identified transect soil and humus samples will be collected in the following manner:

a. At each sampling point, a soil sample to a depth of two inches will be collected. Care should be taken to prevent sample contamination from kneeling or walking on the sample site

b. Soil samples will be composited in a prelabled container as the samples are collected along the transect.

c. Information on whether the sample point is compacted, eroded, displaced or located in a skid road/landing will be recorded.

d. For posttreatment sampling, samples will be taken as close as possible to the same site sampled previously to avoid introducing added variability.

e. When present, duff and litter samples will be collected and noted along the transect. If at the completion of the transect additional humus sample is needed, additional sample collection will be made from the sample points with duff and litter present.

f. Information on the presence and thickness of the duff and litter will be recorded.

Extra care should be used when sampling after application as most of the herbicide will be on the vegetation, duff and litter or in the upper few mm of the soil. The potential for contamination in the detection level of 1ppb is high at this point.

To prevent cross-contamination rubber gloves will be worn when sampling and will be changed between each transect. Sampling tools and hands will also be cleaned thoroughly between transects.

B. Storage

To limit herbicide breakdown, samples will be kept cool (ice chest/refrigerator) and sent to the laboratory within 24 hours of sampling.

5. SAMPLING FREQUENCY

As noted earlier, the sampling will involve a pretreatment soil and humus sample, a posttreatment sample and a resampling to determine herbicide breakdown. The following information describes the conditions for these sampling periods.

A. Pretreatment Sampling

Soil and humus sample will be collected within 30 days of the planned application date. This limited sampling period will reduce the risk of contamination from other work in the area.

B. Posttreatment Sampling

For all liquid formulations of the applied herbicide, soil and humus sampling will take place within 15 days of application. Changes in environmental conditions (such as rainfall) since application should be noted.

For all granular formulations of the applied herbicide, soil and humus sampling will take place within 15 days of herbicide activation or at the first opportunity to access the site (such as fall application in snow country).

C. Follow-up Resampling

One year after application all monitoring units will be resampled along the identified transects. In units that showed no residues in the posttreatment sampling the amount of sampling may be modified or eliminated.

6. DATA ANALYSIS AND FOLLOW UP

Each Forest will establish a procedure for evaluating, distributing and storing the monitoring information. As a minimum, a Silviculturist and Soil Scientist should review the monitoring results on a yearly bases and based on this review make recommendations on future program monitoring needs.

Identified special study needs should be brought to a regional level and special studies identified and designed to address the issue.

SOIL QUALITY STANDARD MONITORING

The soil characteristics of soil cover, and less than three inch organic material have been selected as key soil productivity related characteristics to be monitored in this projects area. In particular, stands receiving broadcast burning as a site preparation and fuel reduction treatment will be monitored using Forest Plan Alternative monitoring direction. This monitoring will be implemented after the broadcat burning has been completed in a given year, and after the completion of the entire project. Soil erosion will also be monitored at these sites using silt fence catchment devices.

All broadcast burn treatments in all alternatives will be evaluated after treatment to determine if remedial action is necessary to meet soil quality standards.

APPENDIX 3

EXPECTED TIMBER YIELDS, ECONOMIC COSTS AND RETURNS

1.Timber Yield Calculations:

The timber yield calculations are based on values given in "Yield of Even Aged Stands of Ponderosa Pine", W.H. Meyer, 1938, U.S. Dept. of Agriculture Bulletin No. 630. Yields are calculated at age 100. Volumes are in Scribner board foot volume. Final harvest is assumed to take place at age 100, on average. This conforms to the management scheme assigned to these stands in the FORPLAN model used in the Forest Land Management Plan.

Timber yields were estimated in a format similar to Appendix D of the R5-FEIS, with site-specific data replacing Regional R5-FEIS values. Forest Survey Site Class (FSSC) 4 has been used to estimate yields for all units.

With large analysis areas, yield calculations can only be used as a relative indicator between alternatives. The adjustment value in column 3 (tables 1-4) is a relative value used to adjust yield. It is based upon hardwood retention levels, the type and amount of other competing vegetation growing within the units, and the relative effectiveness of the release treatment (if any) being applied. Expected control levels were set for competing vegetation for a summary of the treatment combinations and a yield reduction was calculated based on these estimates.

These calculations assume only one release treatment per stand, as analyzed in this document. **One-hundred percent yield was not estimated even where herbicides are prescribed for use due to expected deficiencies inherited when implementing such a large program of work.**

The yield calculations described in the following tables assume no losses due to fire, only reductions due to competition from hardwoods and other vegetation.

Table 01 Yield Estimate for Alternative 1

Acres	MBF/A	Adjustment	Yield
10,992	42.1	0.95	440MMBF
758	42.1	0.50 (Oak36)	16MMBF

Table 02 Yield Estimate for Alternative 2

Acres	MBF/A	Adjustment	Yield
8,421	42.1	0.95	337MMBF
2,467	42.1	0.50 (Oak36)	52MMBF
862	42.1	0.75 (Oak20)	27MMBF

Table 03 Yield Estimate for Alternative 3

Acres	MBF/A	Adjustment	Yield
7,898	42.1	0.95	316MMBF
2,374	42.1	0.50 (Oak36)	50MMBF
807	42.1	0.25 (Oak20)	25MMBF

Table 04 Yield Estimate for Alternative 4

Acres	MBF/A	Adjustment	Yield
3,944	42.1	0.95 X 0.30	47MMBF

2. *Economic Cost Analysis:*

The following tables illustrate the differences in total project cost between alternatives. Only those costs related to reforestation and release treatments are included. Project planning, monitoring, and fire protection costs were not included in this analysis.

Table 05 Economic Cost Analysis- Alternative 1

Treatment	Treatment Acres	Cost/Acre	Treatment Cost
Broadcast burn	1,127	$135	$152,145
Aerial Site Prep-Hexazinone	7,560	$105	$793,800
Ground Site Prep-Gly.	262	$253	$66,286
Ground Site Prep-Gly./Tri.	262	$253	$66,286
Ground Site Prep-Hexazinone	148	$224	$33,152
Tree Planting	7,970	$231	$1,841,070
Tree Interplant	3,780	$87	$328,860
Aerial Release-Hexazinone	3,260	$105	$342,300
Ground Release-Gly./Tri.	12,093	$250	$3,023,250
Ground Release-Hexazinone	177	$224	$39,648
Hand Release-Grubbing	0	$395	$0
Total Cost			$6,686,797

Table 06 Economic Cost Analysis- Alternative 2

Treatment	Treatment Acres	Cost/Acre	Treatment Cost
Broadcast burn	1,127	$135	$152,145
Aerial Site Prep-Hexazinone	7,560	$105	$793,800
Ground Site Prep-Gly.	262	$253	$66,286
Ground Site Prep-Gly./Tri.	262	$253	$66,286
Ground Site Prep-Hexazinone	148	$224	$31,152
Tree Planting	7,970	$231	$1,841,070
Tree Interplant	3,780	$87	$328,860
Aerial Release-Hexazinone	3,260	$105	$342,300
Ground Release-Gly./Tri.	12,093	$250	$3,023,250
Ground Release-Hexazinone	177	$224	$39,648
Hand Release-Grubbing	0	$395	$0
Total Cost			$6,686,797

Table 07 Economic Cost Analysis- Alternative 3

Treatment	Treatment Acres	Cost/Acre	Treatment Cost
Broadcast burn	456	$135	$61,560
Aerial Site Prep-Hexazinone	0	$105	$0
Ground Site Prep-Gly.	262	$253	$66,286
Ground Site Prep-Gly./Tri.	262	$253	$66,286
Ground Site Prep-Hexazinone	7,037	$224	$1,576,288
Tree Planting	7,299	$231	$1,686,069
Tree Interplant	3,780	$87	$328,860
Aerial Release-Hexazinone	0	$105	$0
Ground Release-Gly./Tri.	11,381	$250	$2,845,250
Ground Release-Hexazinone	3,478	$224	$779,072
Hand Release-Grubbing	0	$395	$0
Total Cost			7,409,671

Table 08 Economic Cost Analysis- Alternative 4

Treatment	Treatment Acres	Cost/Acre	Treatment Cost
Broadcast burn		$135	
Aerial Site Prep-Hexazinone		$105	
Ground Site Prep-Gly./Tri.		$253	
Ground Site Prep-Hexazinone		$224	
Tree Planting		$231	
Tree Interplant		$87	
Aerial Release-Hexazinone		$105	
Ground Release-Gly./Tri.		$250	
Ground Release-Hexazinone		$224	
Hand Release-Grubbing	5,725	$395	$2,261,375
Total Cost			$2,261,375

3. Cost and Revenue Projections by Alternative:

Cost projections for this analysis used only those costs directly related to the reforestation and release treatments. Costs for monitoring, fire protection, and project planning were not included in this analysis. Tables 5-8 display the costs by treatment for each alternative.

The average stumpage value for pine stands used in the Stanislaus Land Management Plan was $140/mbf, based on sales from 1983-87 on the Stanislaus and on tractor yarding. It was assumed that stumpage prices would increase at 1% per year for the next 50 years in accordance with historical trends. Recent major changes in federal timber supply, however, have led to rapidly escalating stumpage prices for ponderosa pine in the local area and on the west coast in general. Wholesale prices for ponderosa pine lumber have climbed by over $300 per mbf over levels in 1983-87. Stumpage prices in recent quarters have averaged roughly $200 above the 1983-87 levels. While prices are expected to drop somewhat as the market adjusts to the long term reduction in supply, prices should remain significantly above the levels projected in the forest plan. For purposes of this analysis, we assume that the base stumpage value for pine stands is $300/mbf. Timber value is based on final harvest at age 100 and reflects only the value of the timber without considering costs for preparing and administering those future sales.

Given the assumptions above, the estimates for costs and revenues for each alternative are detailed in the following table. All costs and revenues are discounted at 4% per year to reflect the time value of money. By discounting all future costs and revenues at 4% we can put them all on an equivalent value basis, ie. what those dollars would be worth in terms of dollars today (present value).

Table 09 Present Value of Costs and Benefits
(Million Dollars, Discounted)

Alternative	Acres	Project Cost	Timber Value	Net Return
1	11,750	$6.7	$34.8	$28.1
2	11,750	$6.7	$31.8	$25.1
3	11,079	$7.4	$29.9	$22.5
4	3,944	$0.2	$3.6	$3.4

Economic Impact: The expenditure of funds for reforestation will have a positive impact on local employment and income. The total impact will vary by the amount of project dollars that are spent in the local area. In the past, local contractors have accounted for about 50% of the bids awarded for site prep, planting and release. Assumptions about the number of jobs generated by type of activity are taken from the Vegetation Management for Reforestation EIS (Volume II, p.4-130, Table 4-41), published by the Pacific Southwest Region of the Forest Service in 1988. Assuming 50% of the work will go to local contractors, the total employment impacts in the local area are estimated in Table 10. It should be noted that expenditures of federal funds in the local area do not necessarily result in a net increase in jobs for the national economy. Taxes collected or borrowed from the private sector will result in some reduction of private sector employment.

Employment and Income Effects in the Local Area

TABLE 10 Person-Years of Employment

Alternative	Direct	Indirect
1	189	189
2	189	189
3	235	235
4	70	70

APPENDIX 4

BIOLOGICAL EVALUATION

Prepared for the

PAPER REFORESTATION AND RESOURCE RECOVERY PROJECT

STANISLAUS NATIONAL FOREST

MI-WOK RANGER DISTRICT

PREPARED BY: Tom Rickman, Wildlife Biologist DATE: August 13, 1993

REVIEWED BY: Tom Beck, Forest Biologist DATE: August 13, 1993

I. INTRODUCTION

The purpose of this Biological Evaluation is to review the proposed Paper Reforestation and Resource Recovery project, on the Mi-Wok Ranger District of the Stanislaus National Forest, to determine its effect on species of concern, and to determine whether proposed actions will result in a trend toward a Sensitive species becoming Federally listed. This Biological Evaluation is prepared in accordance with direction in FSM 2672.4.

The proposed project would establish conifer-hardwood forest by treating competing vegetation on up to 11,750 acres which were burned during the Complex Fire of 1987. Methods of treating competing vegetation would include ground and aerial applications of herbicides. Broadcast burning is also proposed within and adjacent to plantations to reduce fuel loadings. A full discussion of the proposed project and environmental consequences is available in the Draft Paper Environmental Impact Statement (DPEIS; Stanislaus National Forest, 1993), which assesses the effects of five project alternatives. This Biological Evaluation analyzes the potential effects of the proposed action. The proposed project is located north of the Tuolumne Wild and Scenic River canyon and northwest of the Clavey River canyon, east of the North Fork Tuolumne River and south of Basin and Cottonwood Creeks. Elevation range within the project area is 2,500 feet near Paper Cabin Ridge to 5,835 feet at Duckwall Mountain.

Potential impacts of this proposed project to Federally listed species is addressed in a separate Biological Analysis. This document addresses only the potential affects to Sensitive species. Sensitive species which inhabit the range and elevation in which this project is proposed to take place include one Sensitive plant species (Tuolumne fawn lily [*Erythronium tuolumnense*]), and nine species of Sensitive birds and mammals. These nine species are: California spotted owl (*Strix occidentalis occidentalis*), western pond turtle (*Clemmys marmorata*), California red-legged frog (*Rana aurora*), fisher (*Martes pennanti*), pine marten (*Martes americana*), Sierra Nevada red fox (*Vulpes vulpes necator*), northern goshawk (*Accipter gentilis*), willow flycatcher (*Empidonax trailli*) and great gray owl (*Strix nebulosa*). Three other Sensitive plant species, *Allium tribracteatum*, *Lomatium stebbensii*, and *Silene invisa* are known from or have potential to occur on the Mi-Wok Ranger District, however suitable habitat for these plants is not found within the project boundaries.

II. CURRENT MANAGEMENT DIRECTION

As stated above, the project area contains potential habitat for nine Sensitive wildlife species and one Sensitive plant species. Three of the nine Sensitive wildlife species (the California spotted owl, northern goshawk and western pond turtle) have been located within or immediately adjacent to the project boundaries. Also, two tadpoles, tentatively identified as California red-legged frog tadpoles, were located within the project boundaries. One of the tadpoles was collected and is undergoing further investigation to determine species. However, positive identification of this individual was not available at the time of this writing. Surveys specific for the five other Sensitive wildlife species either have not been conducted in the area or have been incomplete in coverage. Several populations of the Tuolumne fawn lily are located within the project boundaries. Management direction for all Sensitive plant and wildlife species which may inhabit the project boundaries are given below.

A. Sensitive wildlife species

California spotted owl

On March 31, 1993, Region 5 adopted new interim policy direction for spotted owl management as recommended by the California Spotted Owl (CASPO) Technical Team. This new direction is designed to retain and protect habitat components most at risk and difficult to replace (such as very large, old trees), and to protect spotted owl nest and roost sites. The CASPO guidelines are to remain in effect during a two to five year interim period in which permanent management guidelines for the California spotted owl are to be generated and adopted. Briefly stated, the CASPO guidelines maintain existing, 1,000 acre Spotted Owl Habitat Areas (SOHAs), and also create 300 acre Protected Activity Centers (PACs) around all known owl sites documented since 1987. Stand altering activities are to be avoided within SOHAs and the PACs, however, light underburning which would minimize removal of duff and large woody material is allowed. This new direction also places guidelines on timber harvest outside of SOHAs and PACs, and requires certain amounts of basal area and canopy cover to be left within harvest units. For a full description of this direction, refer to the California Spotted Owl Sierran Province Interim Guidelines Environmental Assessment (USDA Forest Service, 1993). The California spotted owl is listed by the US Fish and Wildlife Service (USFWS) as a Candidate 2 species, meaning that while there is some evidence of vulnerability, substantial biological information to support Federal listing of the species is not available at this time.

Western pond turtle and California red-legged frog

These two species were designated as Forest Service Sensitive on June 1, 1993, and have no specific management requirements set forth by the Stanislaus National Forest Land and Resource Management Plan (LMP; USDA Forest Service, 1991). These species will be managed under the umbrella direction for all Sensitive species which is to ensure conservation or enhancement of their populations and habitats so that the species do not become Federally listed or suffer loss of viability. California red-legged frogs are listed by the USFWS as a Candidate 1 species, meaning the agency has sufficient information on the species' vulnerability and threat(s) to support Federal listing; development of and publication of proposed rules for Candidate 1 species are anticipated. The subspecies of the western pond turtle which inhabits the Stanislaus National Forest is listed by the USFWS as a Candidate 2 species.

Northern goshawk

The LMP (U.S.D.A. Forest Service, 1991) requires the establishment of a network of 58 goshawk breeding territories, with the size of each territory to be from 50 to 120 acres, with 120 acres being the optimum. Within these territories there is to be no harvest unless it improves or maintains the condition of the stand for the goshawk. The LMP also states that no timber harvest, road building, or other disturbing activities are allowed within 0.3 miles of an active nest from March 1 until at least four weeks after the young have been fledged, or September 30 if the fledging date has not been determined for a particular nest. Less than half of the desired 58 territories have been identified on the Forest. The northern goshawk is listed by the USFWS as a Candidate 2 species.

Great Gray Owl

Great gray owl nest territories are provided with special management considerations on the Stanislaus National Forest. Nest territories are protected from management activity by protec-

tion of the nest and a 300-yard area around foraging meadows, and a minimum stubble height is maintained in meadows in which nesting pairs forage. These managment guidelines are in effect where breeding has occurred at least once, or where, in a five year period, the owls are detected in at least two years. The great gray is not listed by the USFWS as a Candidate species for Federal listing.

Willow Flycatcher

Management direction provided in the LMP for this species is to provide suitable nesting habitat in occupied areas and selected potential areas according to the habitat capability model for the species. In areas where willow flycatchers are known to occur, maximum foliage density of shrubs and grass within six feet of the ground will be maintained at least through the first part of the summer. The subspecies of willow flycatcher which inhabits the Stanislaus National Forest is not listed by the USFWS as a Candidate species for Federal listing.

Marten

The LMP identifies 84 marten reproductive units, designed to maintain a population of 500-550 individuals. Most of the reproductive areas are located in established Wilderness areas. The pine marten is not listed by the USFWS as a Candidate species for Federal listing.

Pacific Fisher

The LMP identifies 19 areas to meet reproduction and dispersal needs of the fisher. The 19 reproductive areas are designed to sustain a population of 100-125 individuals. Areas vital to movement across the Forest to adjoining Federal lands will be managed to either maintain or achieve high habitat capability. The fisher is listed by the USFWS as a Candidate 2 species.

Sierra Nevada Red Fox

Specific direction in the LMP for the management of this species is lacking. The species will be managed under the blanket direction afforded to all Sensitive species, in that it will be managed to ensure conservation or enhancement of their populations and habitats so that the species does not suffer a trend towards Federal listing or a loss of viability. The USFWS lists this species as a Candidate 2 species.

B. Sensitive plant species

Tuolumne fawn lily

Management direction on the Stanislaus National Forest is provided for the Tuolumne fawn lily by the Interim Management Guide for *Erythronium tuolumnense* (Haas, et al, 1990). This plant grows on cool, north-facing slopes containing moist soils during the flowering period. There are approximately 25 known populations of this species, all of which are located on the Mi-Wok Ranger District within drainages tributary to either the Tuolumne River or the South Fork of the Stanislaus River, at elevations of 1,200 to 5,000 feet. The plant is very ephemeral, appearing in early spring and withering soon after flowering. The plants may be completely browned and withered by early June. Activities with the most potential to impact populations of fawn lily are those such as plant collecting, recreation (specifically off-road vehicle use and camping), road building and hydroelectric projects. The primary impacts which could result from the above activities are loss of populations and habitats, damage to plants and soil compaction. Site

preparation and other timber activities have potential to impact populations of this species. The Interim Managment Guide states that "Herbicides will not be applied to any population during the critical growing period (March, April and May)", and that, within known populations, "Pre-emergent herbicides will not be used at any time of the year." The USFWS lists the Tuolumne fawn lily as a Candidate 2 species.

III. DESCRIPTION OF PROPOSED PROJECT

The primary purpose of the proposed project is the reestablishment of a conifer-hardwood forest within an area burned during the 1987 Complex Fire. Alternative 1 of the DPEIS proposes to reforest 11,750 acres, using available vegetation control techniques, including ground and aerial herbicide applications to control competing grasses, forbs and shrubs. Of the 11,750 acres, 3,780 have previously been deep-tilled and planted, leaving a remainder of 7,970 acres to be fully site-prepped and planted. The areas proposed for treatment are located within the Murphy, Cotton, Matsen, Bear Springs, Paper Cabin and Walton Cabin management compartments of the Mi-Wok Ranger District. A brief summary of each of the five Alternatives discussed in the DPEIS is given below.

Alternative 1 - Reforestation of 11,750 acres using aerial and ground applications of hexazinone, and ground applications of glyphosate and triclopyr. Broadcast burning would take place on approximately 3,332 acres. By year, the number of acres on which hexazinone would be applied (acres in parentheses is the acreage to be treated by aerial applications) are: 1994: 6,276 (5,951); 1995: 1,994 (1,994); 1996: 2,875 (2,875).

Alternative 2 - Reforestation of 11,750 acres using aerial and ground applications of hexazinone, and ground applications of glyphosate and triclopyr. Broadcast burning would take place on approximately 3,332 acres. Alternative 2 identifies higher levels of oak retention than does Alternative 1, otherwise the two alternatives are very similar. The number of acres on which hexazinone would be applied both aerially and on-the-ground are identical to Alternative 1, above.

Alternative 3 - Reforestation of 11,079 acres using only ground applications of hexazinone, triclopyr and glyphosate. Broadcast burning would take place on approximately 2,661 acres. This alternative provides a greater retention of oaks than either of the previous alternatives, and is tailored to meet long-term deer habitat requirements. By year, the number of acres on which hexazinone would be applied are: 1994: 6,112; 1995: 1,777; 1996: 2,626.

Alternative 4 - No herbicides would be applied. Reforestation would be limited to 3,944 acres which have previously been deep-tilled, and 164 acres which have naturally regenerated. Broadcast burning would take place on 2,205 acres to reduce fire risks to the planted areas.

Alternative 5 - The No Action alternative. No reforestation activities would take place under this alternative.

Watersheds of five creeks (Bear Springs, Duckwall, Grapevine, Hunter and Quilty) are included within the project boundaries. These watersheds, their size in acres and the approximate number of acres by year which would be treated by hexazinone under Alternatives 1 and 3 are

given below. (The proportion of the five watersheds affected under Alternative 2 is essentially the same as for Alternative 1.)

Alternative 1: Acres of Aerial Hexazinone Application

Watershed (acres)	1994 acres	(%)	1995 acres	(%)	1996 acres	(%)	Total acres	(%)
Bear Springs (2381)	156	(07)	33	(01)	5	(00)	194	(08)
Duckwall (4356)	392	(09)	430	(10)	72	(02)	894	(21)
Grapevine (4525)	1529	(34)	0	(00)	1097	(24)	2626	(58)
Hunter (9552)	2218	(23)	1207	(13)	791	(08)	4216	(44)
Quilty (1091)	176	(16)	0	(00)	0	(00)	176	(16)

Alternative 3: Acres of Aerial Hexazinone Application

Watershed (acres)	1994 acres	(%)	1995 acres	(%)	1996 acres	(%)	Total acres	(%)
Bear Springs (2381)	107	(04)	33	(01)	5	(00)	145	(05)
Duckwall (4356)	361	(08)	419	(10)	72	(02)	852	(20)
Grapevine (4525)	1587	(35)	0	(00)	1038	(23)	2625	(58)
Hunter (9552)	1940	(20)	1001	(10)	709	(07)	3650	(37)
Quilty (1091)	280	(26)	0	(00)	0	(00)	280	(26)

Potential impacts to Sensitive species are greatest under Alternatives 1 and 2, due to extensive aerial application of hexazinone, therefore the following discussion on potential effects on species of concern will be focused on the application rates proposed under these two Alternatives. Herbicide applications would begin within the deep-tilled areas in March of 1994 with applications of Pronone 10G, the granular form of the herbicide hexazinone. Backpack applications of the herbicides glyphosate and triclopyr would occur in May and June. Aerial applications of hexazinone would be restricted from a 100 foot buffer around streams, creeks and other water sources, a 50 foot buffer would be observed during backpack operations. No buffers would be provided for ephemeral drainages. Planting of conifers would begin in deep-tilled areas in early 1995. Additional applications of glyphosate and tricolpyr would occur in May, 1995, to treat missed areas or recovering vegetation.

Broadcast burning is scheduled as site preparation on 906 acres in 1994, with another 191 acres scheduled for 1995 and 30 acres for 1996. From 1994-1996, burning is scheduled on 2,205 acres outside of areas planned for reforestation to reduce fuel loadings and danger of plantation loss from fires.

Conifer species to be planted include ponderosa pine (comprising up to 70% of the mix), Douglas fir, sugar pine, incense cedar and white fir. The project calls for retention of oaks according to levels specified in the Stanislaus National Forest Land and Resource Management Plan (LMP; USDA Forest Service, 1991); oak retention goals include levels of 10, 20, and 36 square feet of oak basal area per acre depending on the emphasis given for deer management.

IV. EXISTING ENVIRONMENT

A variety of vegetation types existed within the project boundaries prior to the 1987 fires. Ponderosa pine, mixed conifer, black and canyon live oaks were intermixed throughout the area. Digger pine, oaks, chaparral and annual grasslands were common in the lower elevations. Currently, much of the area is now vegetated primarily by shrubs (such as manzanita, deerbrush, toyon, yerba santa and bear clover), black and canyon live oak, grasses and forbs. White alder, big-leaf maple, dogwood and willow have resprouted within riparian areas along Hunter, Grapevine and Bear Springs creeks. A total of 3,807 acres of surviving forested islands are located within the project boundaries, and an additional 2,400 acres of forested islands are located adjacent to areas proposed for reforestation activities. Much of these 5,400 acres of forest are in late seral stages.

The following section provides species and habitat accounts for the Sensitive plant and wildlife species within the proposed project area. Much of the information given in the "Habitat Account" sections for each species was drawn from the Biological Evaluation for Drought-Related Timber Salvage on National Forests of the Sierra Nevada Province--Threatened, Endangered, Sensitive, and Proposed Animals (MacFarlane, 1992).

California Spotted Owl

Species Account

Boundaries of the proposed project abut the boundaries of two SOHAs, SOHA M16 and SOHA M11. Within SOHA M16, several detections of spotted owls have been recorded within 0.25 miles of one unit proposed for site-prep activities in 1994 and two units proposed for site-prep activities in 1995. These detections of spotted owls include two detections in 1992 and one in 1990. Within SOHA M17, a 1992 spotted owl detection and a 1991 detection are within 0.25 miles of units proposed for site-prep activities in 1996. All of the above mentioned detections of spotted owls were of single birds. Spotted owl surveys were conducted to protocol standards in 1992 in suitable habitat within the proposed project boundaries in the Cottonwood, Murphy, and Bear Springs compartments. These surveys resulted in a discovery of one new activity center, located in a remnant stand of forest in the Bear Springs compartment. Further surveys in this area in 1993 documented a nesting pair which fledged two young. This site has been incorportated within a 300 acre PAC as per current CASPO guidelines. Several proposed site prep units are within the boundaries of this PAC, including two units scheduled for site-prep in 1994, portions of four units scheduled for site prep in 1995, and a portion of one unit scheduled for 1994 release.

Islands of forested habitat which survived the 1987 fires within the Walton and Matsen compartments have not been surveyed for spotted owls. The above mentioned nest, located within a green island in the Bear Springs compartment, indicates potential for additional spotted owl activity centers to exist in these unsurveyed islands.

Habitat Account

Suitable habitat for this species is typically coniferous forests characterized by multi-layered, multi-species canopies with moderate to high canopy closure (70%). The canopy is typically dominated by large overstory trees with open space beneath the canopy closure, with the overstory trees featuring various stages of decadence including broken tops, cavities, and large snags. Downed logs and other woody debris are abundant on the forest floor. Foraging habitat can include medium to large tree stands with 50% or greater canopy closure. These types of habitats are most often found in the late seral stages of mixed conifer forests on the Mi-Wok Ranger District. Atypical suitable habitat generally consists of deep, shaded canyons densely grown to oaks or other hardwood species, and which may contain a scattered overstory of conifers.

Suitable habitat within the project boundaries is restricted largely to the 3,807 acres of remnant forested stands which survived the fire. An additional 2,400 acres of forested islands exist adjacent to areas planned for reforestation. Some additional suitable, atypical habitat may exist in the river canyons and other major drainages in the lower elevations of the project area.

Northern goshawk

Species account

There has been one northern goshawk reported within the project boundaries. In 1992, a single goshawk was observed within the Murphy compartment, near the common boundary of a large forested island and a unit scheduled for 1995 site-prep. No surveys for this species have been conducted within the area.

Habitat account

Optimal habitat for this species include the large-tree stages of mixed conifer, red fir, Jeffrey and ponderosa pine forests. Smaller tree stages of the same forest types as well as aspen habitats and lodgepole pine provide additional suitable habitat. Nest stands are characterized by high canopy cover (60-100% is optimal, 50-59% is suitable and 30-49% is marginal), and are generally located on gentle to moderate slopes on north or northeast aspects.

Remnant stands of forest within and adjacent to the project boundaries provide potential habitat for this species. The Walton, Matsen and Murphy compartments contain forested islands of large enough size to provide foraging and possibly nesting habitat for goshawks.

Pine marten

Species account

Pine martens have not been reported within or adjacent to the project boundaries. The nearest sighting on record took place approximately 7 miles to the northwest of the project boundaries. Surveys for this and other furbearer species have not been conducted within the project boundaries.

Habitat account

Suitable pine marten habitat is typically composed of high-elevation, medium- to late-seral-stage forests with riparian and small-meadow habitats interspersed are most suitable for the marten. Snags and downed logs are important habitat components. High canopy closure (60-100%) also characterizes preferred habitat. Elevation range for marten in the northern Sierra is from 3,400 to 10,400 feet; in the southern Sierra the elevation range is from 4,000 to 13,100 feet.

Very little habitat exists in the area of the proposed project for this species, and areas of suitable forested habitat which does exist is highly fragmented into islands of remnant stands. Also, much of the proposed project is below elevations typically inhabited by this species. Marten may be able to travel into the project area from adjacent habitats, such as is provided within the two SOHAs, and may be able to gain access and forage within some of the forested islands. However, overall habitat capability for this species is extremely low.

Fisher

Species account

Fishers have not been reported within or adjacent to the project boundaries. The nearest reported fisher sighting is approximately 5 miles northeast of the proposed project. Surveys for this and other furbearer species have not been conducted within the project boundaries.

Habitat account

This species inhabits late seral stages of mixed conifer, Douglas fir, montane hardwood-conifer, ponderosa pine, lodgepole pine and riparian habitats, at elevations ranging from 4,000 to 8,000 feet in the southern Sierra. Dense canopied (60-100%), multi-storied, late-seral stage stands are the preferred habitat type, especially when in close proximity to riparian corridors. Riparian areas provide important travel corridors for this species.

Very little habitat exists in the area of the proposed project for this species, and areas of suitable forested habitat which does exist is highly fragmented into islands of remnant stands. Also, much of the proposed project is below elevations typically inhabited by this species. Fisher may be able to travel into the project area from adjacent habitats, such as is provided within the two SOHAs, and may be able to gain access and forage within some of the forested islands. However, overall habitat capability for this species is extremely low.

Sierra Nevada red fox

Species account

Sierra Nevada red foxes have not been reported from within the proposed project boundaries. The nearest locations in which this species have been reported are approximately 4 miles to the northwest and approximately one mile to the north of the project boundaries. No surveys for this or other furbearer species have been conducted within the project boundaries.

Habitat account

This species inhabits mixed conifer and true fir forests, as well as lodgepole and ponderosa pine dominated stands. Forested areas interspersed with meadows and brush fields are preferred. This species occurs primarily over 7,000 feet, and is rarely encountered below 5,000 feet in elevation. Red foxes may be more tolerant of openings than either fisher or pine marten. Although very little information is available for this species, it is assumed that if habitat requirements for pine marten and fisher are met, the habitat requirements for this species will also be met. Red foxes, being more tolerant of openings than fisher or marten, may be able to more fully utilize the islands of forested habitat within the project boundaries.

Great gray owl

Species account

Great gray owls have not been detected within or adjacent to the project boundaries. However, no surveys specific for this species have been conducted in the area. The nearest known location for this species is approximately 1.5 miles north of the project boundaries.

Habitat account

This species typically forages in wet meadows and nests and roosts in nearby dense (greater than 40% canopy closure) coniferous forest at elevations between 2,500 and 8,000 feet. Both old-growth and second-growth forest are used if suitable nest sites are available. Nest sites have been documented in broken-topped conifer and black oak snags, abandoned hawk nests and artificial nest structures.

Meadows which represent typical foraging habitat for this species do exist within and adjacent to the project boundaries, however this typical habitat is located on private land. There is potential for great gray owls to utilize units proposed for site-prep and reforestation. In 1992, on the Groveland Ranger District, a great gray owl was observed foraging in an area burned during the 1987 Complex Fire, and in 1993 on the Mi-Wok Ranger District great grays were detected in an area burned by the 1992 Ruby Fire. The overall suitability of the proposed reforestation units for this species is unknown at this time. However, recently burned areas vegetated primarily by forbs and grasses, and which provide a suitable prey base of small mammals, should be considered potential foraging habitat for this species, both during the breeding period and during winter when the owls migrate to lower elevations. This potential would be more fully realized when such areas are adjacent to or accessible from remnant stands of forested habitat which would provide daytime roosting habitat and nesting habitat.

Willow flycatcher

Species account

Willow flycatchers have been reported from only four locations within the Stanislaus National Forest. None of these sites are near the proposed project. No surveys specific for this species have been conducted in the area.

Habitat account

Preferred habitat in the Sierra Nevada for this species is primarily mountain meadows which contain water during the breeding season and clumps of willows and/or alders. This species nests within 2.5 to 6.5 feet of the ground and needs dense foliage for this purpose. Presence of water, either running or standing, is also an important habitat component. This species has also been found in other riparian habitats, including willow-lined streams.

The project area contains no meadow habitat suitable for nesting by this species. Some of the riparian areas, such as along Hunter Creek, may provide stopover habitat during migration. The overall value of the units scheduled for site-prep and reforestation is likely very low for this species.

Western Pond Turtle

Species Account

Surveys for amphibians and western pond turtles were conducted in 1993 within the project boundaries along six stream segments. Five of the six survey points of origin were located in the Bear Springs compartment, including surveys on both Hunter Creek (three points of origin) and Bear Springs Creek (two points of origin). The sixth survey point of origin was on Hunter Creek, located on the common boundary of the Murphy and Paper Cabin compartments. No western pond turtles were located during these surveys. However, in 1982, turtles were documented in Hunter Creek near the 1N03 bridge by crews conducting fish surveys. Pond turtle populations likely exist in the Clavey and Tuolumne rivers which border the proposed project, however these rivers were not surveyed in 1993. Populations may also exist in the unsurveyed, lower segments of Grapevine and Bear Springs creeks.

Habitat Account

Western pond turtles historically occurred in a wide variety of permanent and intermittent aquatic habitats, generally below 6,000'. Populations have been found in rivers, streams, lakes, ponds and other seasonal and permanent wetlands. In intermittent streams, pond turtles are able to persist due to large pools which retain water after the main stream course dries (Holland, 1991). Pond turtles require basking sites such as partially submerged logs, rocks, mud banks or emergent vegetation. The presence of suitable refugia, such as spaces under rocks, downed logs, holes in banks and, most importantly, undercut banks, may be a critical factor in the ability of populations to maintain themselves in small streams. Female turtles excavate nest depressions in May, June or July, and the nests are generally located in open areas dominated by grasses or herbaceous annuals, primarily on south- or southwest-facing slopes. Nest distance from water varies considerably, with a known range of 17-402 meters (Holland, 1991). This species has disappeared from 30-40% of its historic range in California. Reasons for the decline include the introduction of predators such as bullfrogs and bass, population fragmentation due to loss and alteration of riparian habitats, and historic commercial and pet trade harvests.

Suitable habitat exists for this species within the Clavey and Tuolumne rivers, which border the proposed project boundaries, and also within Hunter and possibly Bear Springs creeks.

California Red-Legged Frog

Species Account

Surveys for amphibians and western pond turtles were conducted in 1993 within the project boundaries along six stream segments. Five of the six survey points of origin were located in the Bear Springs compartment, including surveys on both Hunter Creek (three points of origin) and Bear Springs Creek (two points of origin). The sixth survey point of origin was on Hunter Creek, located on the common boundary of the Murphy and Paper Cabin compartments. A tadpole tentatively identified as a red-legged frog tadpole was collected from Hunter Creek along the common boundary of the Murphy and Paper Cabin compartments. This tadpole, one of two observed in the stream, was correct in color and conformation for red-legged frogs, however due to the poor condition of the tadpole (the tadpole died upon capture and was then later placed in alcohol, which destroyed much of the tadpole's appearance) positive identification could not be made. Further attempts to positively identify this individual are being made, however results were not available at the time of this writing.

Habitat Account

This is a highly aquatic species which inhabits quiet pools of streams, marshes and ponds below 4,000'. Permanent or nearly permanent pools are required for tadpole development, and the species prefers shorelines with extensive vegetation. This species is now highly restricted in the Sierra Nevada, and has been eliminated from 75% of it's historic range. Habitat loss and alteration, the introduction of bullfrogs and other predators and competitors, and historic commercial harvest have been implicated in the population declines.

Potential suitable habitat for this species exists within the major drainages within and adjacent to the proposed project, including Hunter, Grapevine and Bear Springs creeks and the Clavey and Tuolumne rivers.

Tuolumne Fawn Lily

Species Account

Surveys for Tuolumne fawn lilies have been very limited within the proposed project boundaries; the majority of the potential habitat has yet to be surveyed. Thirteen populations (half of the approximate 25 known populations for this plant) are known to exist within the six management compartments in which the proposed project is located. Units proposed for treatment by this project are within or adjacent to three of these thirteen known populations; the other ten populations would not be at risk.

Habitat Account

This species, endemic to the Mi-Wok Ranger District, grows on shaded, north-facing slopes at elevations of 1,200 to 5,000 feet. Many sites have moist or saturated soils, with rock on or near the surface of the soil which keeps the water column near the surface. Most populations are found in chaparral, oak woodland or ponderosa pine habitats. Potential suitable habitat for this species occurs on the north-facing slopes along Hunter and Bear Springs creeks, and within the drainages tributary to these streams and the Tuolumne River.

V. EFFECTS OF PROPOSED ACTION

A. Direct and indirect effects of proposed project

California spotted owl, northern goshawk, pine marten, fisher and Sierra Nevada red fox

The proposed site-prep and reforestation activities would take place in areas currently unsuitable for these species, and thus would have no direct effect on current levels of habitat. Also, the three herbicides which have been proposed for this project have been shown to have little toxicity to birds and mammals, and do not constitute a direct threat to these species. There would also be little direct threat from the proposed broadcast burning. The burning would be of low intensity and would be located in areas not considered suitable for these species. Also, the above listed species are all very mobile and should, if necessary, be able to easily flee from or avoid areas being broadcast burned.

The primary effect of the proposed project would be the hastening of conifer restoration to the area, which would achieve the return of foraging and nesting habitat for these species more quickly than the No Action alternative discussed in the DPEIS. The actual long-term benefit that reforestation would have for the above listed species would hinge upon future management of the plantations, the age to which they are allowed to mature, and the success of fire suppression efforts in protecting the plantations from wildfires. Young plantations and the overhead cover they would provide may allow for better access by furbearers to the remnant forested stands located within the project area.

The proposed activities do have potential to disrupt the breeding activities of one known reproductive pair of spotted owls, as well as undocumented pairs of owls and goshawks if they are nesting adjacent to proposed units. Aerial applications of herbicides are proposed to begin in March, early in the breeding season for both the owl and goshawk, and at a time where they may be prone to nest abandonment. However, aerial applications within an area or unit would be quickly accomplished, so disturbance from noise should be of short duration. This would reduce the potential for significant disturbance.

Willow flycatcher

The proposed site-prep and reforestation activities would take place in areas currently unsuitable for the willow flycatcher, and thus would have no direct effect on current levels of habitat. Also, the herbicides which have been proposed for this project have been shown to have little toxicity to birds and mammals, and do not constitute a direct threat to this species. Also, riparian vegetation would be largely unaffected by the proposed applications of herbicides and broadcast burning, so potential use of these areas by migratory individuals would not be compromised.

Great gray owl

The proposed reforestation activities would take place in areas which may currently provide great gray owl foraging habitat, both during the breeding season and during winter periods. The project would result in an immediate loss of vegetative cover in the treated units, which would likely lead to a change in small mammal abundance and diversity. Also, reforestation would hasten the recovery of conifer cover to the units. As the young trees developed, the ability of the owls to forage in the treated units would be restricted, since the dense plantations would allow little space for the owls to forage. Though this loss of foraging habitat would occur

gradually through the natural succession of vegetation, the loss due to reforestation activities would by much more immediate and homogenous in nature.

Western pond turtle

The potential for effects to the western pond turtle would primarily be in two areas. Preferred nest sites for this species are characterized by south or south-west slopes vegetated primarily with grasses and forbs, and with little tree or shrub cover. Intensive reforestation efforts adjacent to streams may result in long-term loss of nest habitat for this species.

The second area for potential effects would be possible effects of herbicides on western pond turtles. Of the three herbicides proposed to be applied, hexazinone has the greatest potential to reach open water. The proposed application of hexazinone does not provide buffer zones within dry drainages, leaving open the potential of the herbicide being washed down drainage in the event of rainfall soon after application. The herbicides glyphosate and triclopyr, although more toxic than hexazinone, can generally be applied without contamination of water, they have a short half-life, do not leach through soil and are applied by more precise on-the-ground methods.

Hexazinone appears to be "only slightly toxic" to aquatic organisms; the Environmental Protection Agency describes technical hexazinone as "practically nontoxic" to warmwater and coldwater fish (USDA Forest Service, 1984). The LC_{50} concentration (the concentration at which 50% of the test animals are killed) after 96 hours of exposure for bluegill is estimated at 370-420 ppm, for rainbow trout the estimate is 180 ppm, and for flathead minnow the estimate is 274 ppm (Ibid.). The estimated 48 hour LC_{50} for *Daphnia*, an aquatic invertebrate, is 151.6 ppm, and the 21 day LC_{50} is from 20-50 ppm (Ghassemi, et al, 1981). An estimation has been made of levels of hexazinone which could be expected within streams during this project. This estimate indicates that hexazinone concentrations could reach 2.0 ppm during peak runoff periods in streams directly below treated areas. This concentration would decrease in lower reaches of streams distant from treated areas.

According to criteria developed by the Environmental Protection Agency, if the ratio (Q value) of the estimated environmental concentration to the LC_{50} is less than 0.1, there is no acute toxicity. If the Q value is between 0.1 and 0.5, there is a risk of acute effects that may be mitigated. If the Q value is 0.5 or greater the risk of acute effects is significant. Using the above LC_{50} values for trout as an example, the Q value, for an LC_{50} of 180 ppm and a projected peak hexazinone concentration of 2.0 ppm, would be 0.011, below the 0.1 level of concern. For *Daphnia*, the Q value would be 0.013. Although risk levels for fish and invertebrates may not safely be extrapolated to turtles, it appears that the probable risk of hexazinone exposure to this species is small. Unknowns in this regards include the duration individuals may be exposed to heightened levels of hexazinone in the event of prolonged rainfall events, the affects to female turtles excavating through treated soils when digging nest cavities, the effects of treated soil on eggs, and the effects of water-borne concentrations on newly hatched turtles. Also, potential would exist for accidental spills within or near streams which could lead to elevated concentrations and increased risk.

California red-legged frog

The proposed site-prep and reforestation activities should leave riparian vegetation unaffected along major drainages and stream courses, and so should not directly affect riparian habitats required by this species.

Potential for impacts from the proposed project would likely be one of exposure to herbicides; hexazinone has the greatest potential to reach water sources. Potential impacts from hexazinone would be greatest in 1994, when 6,296 acres are scheduled for hexazinone treatment (Alternatives 1 and 2), including 5,979 acres of aerial application. However, large amounts of acreage are also scheduled for hexazinone treatment in 1995 (1,994 acres) and 1996 (2,875 acres).

Aerial applications of hexazinone would cover a high percentage of two watersheds, Grapevine and Hunter creeks (see tables on page 6). Under Alternatives 1 and 2, approximately 58% of the Grapevine Creek watershed would be treated with aerial applications of hexazinone (34% in 1994 and 24% in 1996), and 44% of the Hunter Creek watershed would be treated (23% in 1994, 13% in 1995, 8% in 1996). Such high levels of treatment within a watershed, especially in Grapevine Creek, could reduce the degree of dilution of hexazinone residues which enter the streams. Also, the yearly treatment (1994-1996) within the Hunter Creek watershed would result in a continual low level presence of hexazinone residue within that stream, since residues from a previous year would still be present within the soil when applications took place the following year. Alternative 3 also involves a high percentage of the same two watersheds (58% of Grapevine Creek, with 35% in 1994 and 23% in 1996; 37% of Hunter Creek, with 20% in 1994, 10% in 1995, 7% in 1996). However, all herbicide application proposed within Alternative 3 would be ground-based, allowing for greater accuracy and control of application compared to aerial applications.

The estimated peak hexazinone concentration (2.0 ppm) within streams segments adjacent to treated units is well below the estimated LC_{50} concentrations for fish and *Daphnia*, indicating a general low risk to aquatic organisms. In order to reach a Q value of 0.1, the LC_{50} for hexazinone on red-legged frogs would need to be 20 ppm, a threshold 9 times lower than for rainbow trout and 7.6 times lower than for *Daphnia*. While this appears to represent a very low potential for effects, studies (Thurston, et al, 1985; Sloff and Canton, 1983; Sloff et al, 1983) which assessed the effects of chemicals on a variety of aquatic species have shown there to be no consistent relative susceptibility of test species to chemicals tested; vulnerability of test species were highly chemical-dependent.

Although potential effects of hexazinone and other herbicides on amphibians is largely unknown, information was obtained from one researcher (Michael Berrill, Trent University, Canada; personal communication, 1993) regarding the effects of hexazinone, triclopyr and glyphosate on three ranid species (*R. clamitans*, *pipiens* and *catesbeiana*). Embryos and newly hatched tadpoles of these species were exposed to hexazinone at 100 ppm for 8 days, after which the eggs and tadpoles showed no ill effects. It would appear from this one study that hexazinone may also be expected to be of low toxicity to California red-legged frogs. Although the test did not include adult frogs, tadpoles, being entirely aquatic and gill-breathing, would likely be more susceptible to water-borne pollutants. Triclopyr proved much more toxic than hexazinone, with complete mortality to tadpoles after a 1 day exposure at >4 ppm. Tests with glyphosate were not sufficient to determine a toxicity level, however paralysis of tadpoles occurred after a 1 day exposure at 8-10 ppm; these tadpoles later recovered.

The results from Michael Berrill's studies indicate that triclopyr is the most toxic of the three herbicides proposed for application by this project. The proposed reforestation project is designed such that neither triclopyr nor glyphosate would likely be introduced into live water, which should minimize risks from these herbicides. It also appears that little risk could be expected from the proposed use of hexazinone. However, potential for accidents and spills would exist which could lead to direct introduction of herbicides into streams. Due to wide-

spread loss of population that red-legged frogs have suffered, further losses which could result from such accidents would be significant.

Tuolumne fawn lily

The proposed applications of herbicides have potential to greatly impact this species. Populations of fawn lilies are often in areas which provide subsurface flow of water. This subsurface flow makes these plants especially vulnerable to hexazinone, which can be carried through the soil by water. Application of hexazinone upslope from fawn lily populations would put those populations at risk if the hexazinone reached the populations via subsurface water flow. Known populations of this plant can be flagged and avoided by project activities, however most of the potential habitat for this species has yet to be surveyed. Although the 1987 Complex Fire eliminated most of the canopy cover in the areas to be treated by this proposed project, sufficiently shaded areas could still exist that maintain suitable habitat conditions. Areas in and adjacent to remnant stands of forest, drainages and seeps partially shaded by shrubs, and steep, north-facing slopes may still offer suitable habitat for this species. The three populations of this plant in or adjacent to proposed treatment units represent about 12% of the total number of known populations. In addition to the dangers from herbicide applications, the proposed broadcast burning could also represent a risk to this species, depending on time of year, intensity of the burn, placement of fire control lines and potential impact from heavy equipment. Again, known populations can be avoided; risks would be greatest to undocumented populations.

B. Cumulative effects

The proposed project will serve to hasten the recovery of coniferous forests on 11,750 acres of land burned in the 1987 Complex Fire. The units proposed for this project are in some areas adjacent to private lands which have previously been sprayed with herbicides and which lack the shrub, grass and forb cover currently exhibited on FS lands. Short-term effects will be loss of this vegetation and the diversity it provides. The plantations which would result from this project would soon return vegetation to the treated areas, though with different species and seral stages than currently existing. All Sensitive wildlife species, except possibly the great gray owl and western pond turtle, would benefit or would be neutrally affected from a return of conifer cover, assuming the resulting plantations are not lost to wildfire prior to reaching the age and structure necessary to provide foraging, nesting and denning habitat for these species. Great gray owls would potentially be negatively affected due to loss of vegetative cover and resulting potential for changes in small mammal diversity and abundance. The resulting dense plantations of young conifers would in time restrict great gray owls from foraging in the treated acres. Plantations, if planted adjacent to suitable riparian habitat, may reduce the availability of suitable nest sites for pond turtles.

This project is one of several similar reforestation efforts that have been proposed, including a 20,000 acre project on the Groveland Ranger District and a 820 acre project on the Calaveras Ranger District, and would add to the acreage previously herbicided on private forest land located within and adjacent to the project area. Additional acreage will likely be treated with herbicides as burned areas and clear cut units are proposed for site-prep and reforestation. Applications of herbicides over such large areas across the Forest could have widespread affects on amphibian species if the species, and their different life stages, are sensitive to the herbicides applied. This is especially true of the very rare California red-legged frog. Impacts could also be significant to Tuolumne fawn lily populations. Due to the widespread, extensive nature of the proposed treatments, all potential habitat would not be surveyed prior to treat-

ment. With only approximately 25 known populations of this plant, loss of individuals or populations would be significant, especially if those losses could be avoided by conducting adequate surveys prior to treatment.

C. Compliance with management direction

All the alternatives discussed within the DPEIS are consistent with the Standards and Guidelines of the Stanislaus National Forest LMP, and comply with Regional direction regarding the application of herbicides, site-preparation and reforestation.

VI. *DETERMINATION*

B. Sensitive species:

***Allium tribracteatum, Lomatium stebbinsii, Silene invisa*:** It is my dermination that this project will not affect these plant species or their habitat because the project area does not contain suitable habitat for these species.

***Erythronium tuolumnense*:** Potential exists for three known populations (about 12% of the total known populations) to be impacted by this project, and additional, undocumented populations could also be at risk from both herbicide applications and broadcast burning. Since approximately 90% of the known populations are not at risk from the proposed project, it is my determination that the proposed project may affect individuals, but would not likely result in a trend toward Federal listing or loss of viability.

California spotted owl, Sierra Nevada red fox, pine marten, fisher, northern goshawk, willow flycatcher: This project would hasten the restoration of coniferous forests on land currently unsuitable for these species; individuals and possibly breeding pairs may be disturbed by project activities. It is my determination that the proposed project may affect individuals, but would not likely result in a trend toward Federal listing or loss of viability.

Great gray owl: The proposed project would alter land currently providing potential foraging habitat for this species. This foraging habitat was created by the 1987 Complex Fires, and would slowly have been lost as the area was naturally revegetated by shrubs and trees; this project would accelerate that loss over a large area. Because the habitat is "atypical" in nature, and use of this area by great grays is largely conjectural (no great grays have been documented in the area) it is my determination that the proposed project may affect individuals, but would not likely result in a trend toward Federal listing or loss of viability.

Western pond turtle: Although data does not appear to exist for the effects of herbicides on this species, the herbicides being applied are considered to be of low toxicity to other aquatic organisms. Streams immediately adjacent to or downstream of treated areas represent marginal habitat for this species. Herbicide residues within streams would likely be highly diluted before reaching areas such as lower Hunter Creek and the Tuolumne and Clavey rivers, which are more likely to contain populations. Therefore, it is my determination that the proposed project may affect individuals, but would not likely result in a trend toward Federal listing or loss of viability.

California red-legged frog: This is a Candidate 1 species, which indicates sufficient biological information currently exists to support Federal listing. One tadpole, possibly of this species,

was located on Hunter Creek within the project boundaries. Hexazinone, which is predicted to reach live water below treated areas at up to 2 ppm, appears to be of little toxicity to ranid frog species. Triclopyr and glyphosate, which, especially in the case of triclopyr, are significantly more toxic than hexazinone, are not expected to contaminate water sources within the project area. However, due to the potential for accidents and spills involving the herbicides and the very rare, localized nature of the remaining populations of this species in the Sierra Nevada, the proposed project does have some potential to impact the species. Since the major potential of impact would arise from accidents which could be avoided with proper safeguards, it is my determination that the proposed project may affect individuals, but would not likely result in a trend toward Federal listing or loss of viability.

VII. *MANAGEMENT RECOMMENDATIONS*

The following measures are recommended to avoid or reduce negative affects on Sensitive species:

(1) Due to the toxicity of triclopyr, minimize the possibility for the introduction of this herbicide into existing water sources. Ensure that triclopyr tanks and containers are kept distant from water. Maintain buffer strips around open water in which applications of triclopyr are restricted. Minimize or eliminate crossing of streams by personnel involved with on-the-ground applications of herbicides, to further reduce chances of accidental spills.

(2) To reduce potential of impacts from the proposed project on Tuolumne fawn lily,
a) Prioritize areas of unsurveyed suitable habitat, and conduct surveys for fawn lilies within these areas prior to site-prep and reforestation activities.
b) Provide buffers around known populations of Tuolumne fawn lilies to reduce potential hexazinone reaching the populations in subsurface water flow. Buffer width for hexazinone application is recommended to be 50 feet to the sides and below population areas, and up to 200 feet upslope of populations. Buffers may be modified upon review of soil conditions, percent slope, etc.
c) Conduct broadcast burning outside of the critical growing period (March through May) for this plant, and locate fire control lines away from known populations and unsurveyed habitat.
d) Conduct post-project monitoring to determine affects on lily populations

(3) Institute a Limited Operating Period of March 1 to August 15 within 0.25 miles of known spotted owl activity centers. No project activities with potential to disturb the owls would be allowed during this time. The LOP could be lifted if protocol surveys determine the owls to be non-reproductive for the year activities are scheduled.

(4) Adhere to CASPO guidelines when project activities take place within PACs or Select and/or Other timber strata, as described in the CASPO guidelines for spotted owl management.

(5) If any Sensitive species are located during project activities, adequate protection measures will be initiated upon recommendations of the District Biologist.

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September 9, 1993

APPENDIX 5

PAPER REFORESTATION
Herbicide Spill/Safety Plan

This plan is an outline of the specific actions to take in case of an accidental discharge of pesticides on National Forest lands, or that might threaten National Forest land during the completion of this operation.

This plan is tiered to and supplements the *Stanislaus National Forest Oil and Hazardous Substances Spills Incident Management and Clean-up Emergency Action Plan* and the *Mi-Wok Ranger District, Stanislaus National Forest, Hazard Material Action Plan*. A copy is filed at the district office.

If a spill occurs in a quantity and location that resource damage might occur, or is a health or safety threat, the Forest Dispatcher will be the first to be contacted by the contractor. The Contracting Officer's Representative (COR) will also be immediately contacted once Dispatch has been reached.

A. *INTRODUCTION*

1) The goal is to prevent any spill or injury from happening during the application of herbicides. Extensive preparation and training will occur prior to contract implementation.

2) In the event of accidental spill, the objective is to take immediate action, in a safe manner, to minimize the spill contamination until specialized personnel and equipment arrives.

3) If the spill involves a vehicle accident, attend to injuries first. Immediately notify the Forest Dispatcher about the spill once first aid has been administered. NOTE: The degree of urgency for environmental monitoring is directly related to the amount of herbicide spilled and its location.

4) Take immediate action to stop the spill by either plugging the leak or doing whatever is safely possible to ensure the spill is stopped from coming out of the source container. Only properly trained and certified personnel may handle the pesticides.

5) Take immediate action to contain the spill by temporarily diverting it from water sources into a local ponding area.

6) If needed, secure available equipment to build ponding areas so the spill does not reach waterways. Under no circumstances should this construction be included if the operator is not qualified to operate the equipment.

7) If efforts to contain the spill fail and the spill enters a waterway, immediate notice of the spill should be given to the Forest Dispatcher so corrective action can be taken as soon as possible.

B. *TRANSPORTATION OF HERBICIDES*

1) Extreme caution must be taken when transporting herbicides.

2) It is essential to take all possible steps to prevent damage to containers to ensure no leaks develop.

3) Special precautions must be taken while loading and unloading herbicide containers on and off vehicles. Containers should be loaded so none can move, roll, or fall during travel periods. It is particularly important to ensure no container could fall from a vehicle.

4) Open containers must never be transported. Partly used containers must be securely re-sealed before movement.

5) Transportation routes should be carefully chosen to limit the number of stream crossings and routes adjacent to stream courses. The contract will specify which routes will be used.

6) After transportation, all herbicide containers should be inspected for leaks, and the vehicle should be carefully examined for contamination.

7) Because decontamination may require replacement of the planking, trucks with wooden beds should not be used.

8) The vehicle should carry ONLY herbicides, never a mixed load. Trucks used to transport herbicides must never be used to transport food, clothing, beverages, household goods, animal feed, or similar commodities without proper cleaning prior to use.

9) Extreme care is necessary in the transportation of empty herbicide containers to a disposal site, particularly to avoid contamination of the truck.

10) All containers must be properly labeled to identify the herbicide.

11) All transport vehicles must be placarded and manifested as required by the U.S. Department of Transportation. A copy of the manifests must be given to the COR, who in turn will provide them to the Forest Dispatcher, prior to transport.

C. *DISPOSAL OF EMPTY HERBICIDE CONTAINERS*

NOTE: In contracts for application of herbicides, government personnel have no disposal responsibilities. The contractor shall dispose of all unused chemical and containers.

1) All empty containers and unused amounts of herbicides must be securely held in a safe and secure herbicide storage area until proper disposal can occur. Copies of disposal chain of custody manifests must be provided to the COR prior to final payment being released.

2) All transport vehicles must be placarded and carry manifests as required by the U.S. Department of Transportation. A copy of the manifests must be given to the COR prior to transport.

3) A regular system of disposal is necessary, empty containers should not be allowed to accumulate.

4) Disposal hazards can be reduced by:

a) Carefully calculating the required herbicide quantities needed so surplus amounts which must be disposed of are reduced to a minimum.

b) Immediately after emptying a container; rinse 3 times with the dilutant used for mixing and pour the rinse into the spray tank load for distribution. Also wash the outside of the container. Volume of rinse should be 10 percent of the volume of the container for each rinse. **This is the first and most important step to container disposal.**

5) The containers must be disposed of ONLY at approved landfills. The contractor is responsible for locating and utilizing approved landfills.

6) Arrangements for disposal need to be made in advance of the delivery of the containers to allow the disposal site operator to have the necessary equipment available to crush and bury the containers.

D. *SPECIAL HERBICIDE TANKER PRECAUTIONS*

1) All valves capable of emptying tanker must be lockable.

2) A separate truck for water collection and transport must be provided by the contractor.

3) Mixing of spray solutions should be done away from streams, drains, ditches leading to streams, or wet areas. Mixing should be done in areas where major spills would be absorbed into the soil before reaching a waterway.

4) Travel adjacent to streams with loaded herbicide tankers should be kept to a minimum through careful planning of routes and necessary spray volumes.

E. *PROCEDURE FOR CONTAINMENT AND CLEAN-UP OF HERBICIDE SPILLS*

The contractor will provide a **specific** spill and employee health and safety plan which must include project specific information. For example, what types of Personal Protection Equipment is necessary for the chemicals being used, names of certified OSHA HAZMAT workers who will be available on site, and establish decontamination procedures for personnel and equipment.

1) Keep contamination to a minimum by quickly and effectively applying decontamination procedures. Well trained personnel are a must.

2) Spill accidents are of two types, emergency or non-emergency. A spill enters into the emergency category if it can NOT be contained at the spill site and kept out of adjacent water systems such as road ditches, streams, and wet areas.

As the first on site response, the COR or Water Monitor will establish the extent and consequence of the spill. The District HAZMAT Coordinator will determine if a spill is significant or not. Specific criteria for the chemicals being used are 100 PPB at the first downstream user. By using the detailed "Spill Evaluation Sheet" (see attached worksheets) calculations can be done to determine the necessary amount of spill to be significant. These will be completed prior to project implementation and will be applicable to units and transportation routes where a risk exists. Stream flows will be taken just prior to project implementation. This will vary depending on the chemical spilled and the location of the spill.

In addition to the COR, the following individuals should be notified as soon as possible should any spill occur.

Forest Dispatcher: (209) 533-1130 (day or night)

District Pesticide Use Coordinator: Joe Sherlock (Office 586-3234)
(Home 586-4256)

District HAZMAT Coordinator: Dave Campodonico (Office 586-3234)
(Home 586-0532)

District Ranger: Ann Denton (Office 586-3234)
(Home 533-1872)

Forest Pesticide Use Coordinator: Mike Rutty (Office 532-3671)
(Home 533-4015)

Forest Supervisor, Coordinator unavailable: Jan Wold (Office 532-3671)

The Forest Pesticide Use Coordinator will notify the Regional Office Pesticide Use Coordinator.

In the event of an emergency spill, the District Ranger will notify downstream users immediately.

3) The Forest Dispatcher will notify all agencies listed in the Forest Spill Plan.

4) Prevent further leakage by repositioning the pesticide container or by safely sealing the leak with rags, tape, or other available materials. Human safety is always top priority and will not be sacrificed when trying to stop a leak.

5) Separate leaking container(s) from other containers.

6) Prevent unprotected personnel from entering the spill area.

7) Consistent with employee qualifications, confine the spill to prevent it from spreading. Encircle the spill area with a dike of absorbent material such as kitty litter for water soluble pesticides, or construct an earthen berm. If necessary, dig a ditch to direct the spill flow away from sensitive areas.

8) Consistent with employee qualifications, cover the spill with an absorbent material if the spill is liquid; if the spill is dry chemical, cover with a plastic tarpaulin and secure. **(Note: Absorbent materials must be disposed of as waste pesticides.)**

9) Prevent ignition of flammable material by eliminating sources of ignition such as exhausts, electric motors, gasoline engines, or cigarettes.

10) DO NOT flush the spill into a ditch, drainage, stream, sewer drain, or off the road, since this serves to further spread the chemical.

11) Use safe removal procedures. Use certified hazardous waste transportation firms and disposal facilities. Provide the COR with copies of disposal manifests prior to final payment release.

a) Carry debris to approved dumping area in tight metal bodied dump trucks or tight containers. Moisten or cover load with disposable cover if dust is a problem. Avoid overloading to prevent spills from occurring enroute.
b) Ground or ditchbanks contaminated with runoff water should be scraped to a depth of 6 inches and disposed of with the rest of the debris. Replace material with noncontaminated soil.
c) Spills from leaking containers found during clean-up should also be treated.
d) Decontaminate tools, vehicles, concrete slabs, and any other object coming in contact with the chemical. Scrub thoroughly and follow with a clean water rinse. Provide for appropriate disposal of decontamination fluids.
e) Inspect the surrounding area for possible contamination and leave entire area safe for the public and wildlife.

12) Use safe disposal procedures at an approved public landfill.

F. *REPORTING ACCIDENTS/INCIDENTS INVOLVING HERBICIDES*

1) All accidents or incidents resulting from herbicide use are to be reported to the Forest Dispatcher who will notify the Forest Pesticide Use Coordinator. The following information should be given to the Dispatcher.
a) Name of Project.
b) Location of spill.
c) What chemical was spilled.
d) Estimate of how much was spilled.
e) Nature of the spill.

2) The report will be by telephone to the Forest Pesticide Use Coordinator from the Forest Dispatcher.

3) The R-5 "Report of Accidental Discharge" Form will be completed for ALL spills regardless of size, with a copy sent to the Supervisor's Office, attention Forest Pesticide Use Coordinator. Keep a copy on the District in a *permanent* file. Make sure it shows the date completed and *is signed*.

4) A follow-up written report covering all details of the accident will be submitted immediately to the Forest Pesticide Use Coordinator. All aspects of the accident or incident should be covered in the written report.

5) Items to be included in the report are:
- a) Names of people involved.
- b) Location of accident or incident.
- c) Date of accident or incident.
- d) Type of accident or incident.
- e) Estimated quantity of spill.
- f) Name and manufacturer of herbicide involved.
- g) Formulation of herbicide.
- h) Weather reading at time of accident or incident.
- i) A detailed narrative statement explaining how the accident or incident occurred and what actions were taken.

6) The Forest Pesticide Use Coordinator in turn will notify the Regional Pesticide Use Coordinator.

G. *PESTICIDE SAFETY*

The Forest Service Health and Safety Code Handbook, section 9-10, addresses safety procedures to be followed while dealing with pesticides. These safety procedures will be used prior to and during all unit inspections. Also, a dye will be used with all applied herbicides to allow easier identification of pesticide placement. In addition, all Forest Service personnel involved with pesticide projects will be licensed Pesticide Applicators with the State of California.

1) Apply pesticides so they do not endanger humans, livestock, crops, beneficial insects, fish, wildlife, or sensitive plants. Do not apply pesticides when the danger of drift leading to the contamination of water or illegal residues is present. Avoid inhaling pesticide sprays or dusts. ALWAYS wear the protective clothing and equipment specified on the label.

a) Use the following basic safety precautions for all herbicides used:
- Wear protective clothing, ie coated tuvak coveralls.
- Wear rubber gloves not penetrable by herbicides.
- Leave no exposed portions of skin.
- Wear appropriate protective goggles, spectacles or face shield and a respirator when required.
- Have eyewash facilities available on site.
- Wash hands and face thoroughly with soap and hot water immediately after working with chemicals, especially before eating.
- Immediately wash off chemical if bare skin is contacted.
- Keep hands or clothing with pesticides on them away from eyes. If solution or dust enters eyes, flush eyes immediately with clean water for several minutes. Consult a doctor immediately.
- Have a minimum of 5 gallons of water, soap, and towels available with each government vehicle.
- Change to fresh clothing each workday. Launder soiled clothes separately from other clothes.

- Wear rubberized protective gear when specified on the label.
- Post manufacturer's antidote where it may be easily read.

b) Transportation of Pesticides:

Pesticides labeled with the signal words "Danger Poison" (skull and cross bones) or "Warning" are considered highly and moderately toxic, respectively. These will be transported to and from the work site along with any related equipment, outside the passenger-carrying portion of vehicles.

Pesticides labeled "Caution" are considered slightly toxic and therefore, may be transported inside the passenger-carrying portion of vehicles when necessary.

1) In all transportation situations, the following basic rules apply:

- All pesticide containers will be securely capped and protected from breakage or spillage. Ripped or punctured bags or cardboard containers will be put into plastic bags or other device to prevent leakage.
- Pesticide containers and related equipment i.e. wands and belly grinders, should be stored in the vehicle in a leak proof case or enclosure.
- Pesticide containers and/or leak proof cases will be securely anchored to the vehicle so as to minimize damage or spillage in the event of an accident.
- Leak proof cases should be locked.
- Pesticides will not be transported to or from the job site in application equipment i.e. wands or belly grinders.
- Pesticide containers and/or leak proof cases will be labeled to show contents and potential hazard.
- Original pesticide containers will carry an EPA approved label.
- Service containers (any container used to hold, store, or transport a pesticide concentrate or diluted preparation other than the original labeled container) will be labeled as follows:
  1) Product name.
  2) EPA registration number.
  3) Name and percent of active ingredient.
  4) Signal word from registered label.

2) Several things are necessary to keep in mind when working with herbicides. Although the herbicides to be used on the Mi-Wok Ranger District are not highly toxic, a good habit to develop is treating them as if they are dangerous chemicals. This cautious approach will minimize exposure and contamination.

Everyone involved with the project must become familiar with the chemicals being used and know the rules for personal hygiene. These include no smoking, eating, or drinking with contaminated hands and washing each day's clothes before wearing them again. Wear regulation field clothing for the job (leather boots, long-sleeved shirt, hard hat, gloves). For safety on wet and slippery units, corks or vibram soles are recommended. Rubber rain gear and boots are not as penetrable by herbicides as leather or cloth and may be rinsed off easily,

but are not required. Rubber boots should have good non-skid soles. Goggles, face masks, and plastic gloves should also be warn as per the label. Each person should carry a canteen for rinse purposes.

When weather conditions exceed label requirements, work will be stopped.

3) Hazard Recognition

The following hazards may be encountered during operations involving use of toxic chemicals.

a) Carrying, loading, and transporting chemicals.
- Lifting heavy loads causing strains or falls.
- Dropping and breaking open containers of chemicals causing a spill.
- Not securing containers properly during transportation causing leaks or spills.

b) Opening containers, measuring, mixing chemicals, and pouring.
- Leaks, spills, volatilization, and dispersion of powders when opening containers, measuring, mixing, and pouring. The hazards are the chemical contacting skin or clothing, breathing in vapors or powders, and splashing chemicals in eyes.
- Prior to dilution, chemicals are in a highly concentrated form and toxicity for each chemical will be maximized.

c) Application hazards (ground/backpack).
- Careless handling of equipment. Spraying oneself or another person. Damaging or abuse of equipment and/or safety devices.
- Clogged nozzles causing possible contact with dilute chemical when clearing obstructions.
- Leaking equipment leading to possible contact with dilute chemical from leaks at gaskets near spray nozzle, in the container lid, and/or in the pump system.
- Possible contamination from normal applications. Spray mist can get on clothing or be inhaled. Contamination of clothing or footwear from walking through sprayed vegetation.

4) Hazard Prevention During Spray Operations

Pesticides can enter the body by one or more of four direct exposure routes.

Oral: This represents a serious potential for contamination. Chemical may be splashed into the mouth while pouring, measuring, or mixing operations. Also by licking the lips, rubbing the mouth, or smoking, eating, or drinking with contaminated hands and fingers.

Dermal: This is usually the primary route of exposure. Although face, neck, armpits, and genitals will absorb chemical more easily, the hands usually have the highest exposure.

Cuts and Abrasions: Chemical may be absorbed very quickly in the blood stream through these surfaces.

Respiratory: Although exposure is at a minimum through the respiratory route, absorption is at a maximum, as almost all of the contaminate inhaled is absorbed internally. Fine dusts may enter during the mixing process, or the diluted mist carried in the air during the ground application may be breathed.

a) Use caution in handling and transporting chemical containers. Make sure containers are secure and leak proof. Carry absorbent material (ie kitty litter) with chemicals in containers for cleaning up leaks.

b) Opening containers, measuring, mixing, and pouring requires complete attention of persons involved. Safety gear (ie plastic gloves, goggles, and dust mask) will be worn during the above procedures.

c) Prevention methods during application include:
- Safety in using equipment will be maintained by keeping spray nozzles down at proper levels and not spraying into the wind. Avoiding damage to equipment will also help maintain safety during use.
- Gloves will be worn and rinse water available while clearing obstructions from a clogged nozzle.
- Leaking equipment if not correctable by tightening joints and lids will be set aside and repaired before further use.

- Contamination from normal application might occur on pant legs and boots. Applicator will rinse rubber boots each day and handle work clothes separately as though they have chemical residue. Rain pants can be rinsed in an appropriate place in the field, freeing practically all chemical residue from them.
- In the event of a spill, the spiller (contractor) is responsible. However, government agencies may initiate removal actions if timely and adequate action is not undertaken by the responsible owner or operator. In order to be prepared, each accompanying government vehicle will contain a spill kit.

d) Watch footing at all times.
- Tailgates and bumpers may be slippery, use caution.
- Unit Hazards: Deep slash, low and trailing vegetation, loose soils and rocks, and dew or rain leading to wet surfaces.

5) Spill Kit and Clean-up Procedures

Each spill kit contains absorbent material oil booms, hand tools, fire extinguisher, road flares, garbage can, and sampling bottles. Personal equipment consists of hard hat, rubber gloves, rain gear, rubber boots, flash light, and first aid kit.

In the event of an accident both the Forest Service and contractor shall:

a) Eliminate fire danger and administer first aid to seriously injured victims.
b) Put out flaggers or flares to prevent additional accidents. **Be careful using flares around spilled material.**
c) Try to prevent the material from entering waterways.
d) Know:

- The chemical spilled.
- Date and time of spill.
- If in water, stream name and exact location.
- An estimate of the amount spilled.
- The concentration; is the spilled material concentrate or mixed chemical?

The contractor shall also:

e) Try to contain liquid either in containers or by ditches and damming.
f) Mop up or absorb as much of the spilled material as possible.
g) Contaminated absorbent material, tools, clothes, and equipment should be stored in a secure area until proper decontamination and disposal can be arranged.

6) Attached are the Material Safety Data Sheets for all the chemicals being analyzed and used with this project (Accord, Garlon 4, and the potential adjuvants).

7) If pesticide exposure should occur, contact the following:

Acute Medical Illness-Emergency Treatment Needed.

UC Davis Regional Poison Control Center
2315 Stockton Blvd
Sacramento, CA 95817
800-852-7221

Fresno Regional Poison Control Center
Fresno Community Hospital and Medical Center
2823 Fresno St.
Fresno, CA 93721
209-445-1222 or 800-346-5922

Poison Control Center
San Francisco General Hospital
San Francisco, CA 94110
415-476-6600 or 800-523-2222

No Acute Illness-Environmental Exposure From Drift, Contaminated Water, or Food.

Walter Kruse, Environmental Health Officer
Tuolumne County Health Department
2 South Green Street
Sonora, CA 95370
209-533-5990

IF IN DOUBT AS TO THE EXPOSURE LEVEL, CALL THE POISON CONTROL CENTER

8) Below is a list of private HAZMAT clean-up companies that may be contacted in case of a large emergency spill:

O.H. Materials Corporation
1425 W. North Market Blvd., Ste. 9
West Sacramento, CA 95834
(916) 372-9100

American Environmental Management Corporation
9719 Lincoln Village Dr., Suite 501
Sacramento, CA 95827
(916) 364-8872

CALPI, Inc.
P.O. Box 16278
Bakersfield, CA 93386
(805) 589-5648

Telic Engineering Corporation

P.O. Box 2078
Stockton, CA 95201
(916) 465-2000

(HAZMAT companies continued)

Reidel Environmental
4138 Lakeside Dr.
Richmond, CA 94803
(415) 222-7810

H & H Environmental Services
220 China Basin
San Francisco, CA 94107
(415) 543-4835

IT Corporation
4585 Pacheco Blvd.
Martinez, CA 94553
(415) 372-9100

Disposal Control Service
1369 West 9th St.
Upland, CA 91786
(714) 983-0342

Crosby & Overton Environmental
8430 Amelia St.
Oakland, CA 94621
(415) 633-0336

APPENDIX 6

PUBLIC SCOPING

PUBLIC PARTICIPATION PLAN

The Forest Supervisor approved the Public Participation Plan for this project. It is on file in the Supervisor's Office in Sonora and the Mi-Wok District Office.

SCOPING LETTER

The following is the text of the scoping letter, dated August 24, 1989, and signed by the Groveland and Mi-Wok District Rangers.

Dear Friend:

The Stanislaus Complex fire of 1987 burned 147,000 acres, including over 60,000 acres of productive timbered forest on the Groveland and Mi-Wok Ranger Districts. Efforts are already underway to reforest much of this productive timberland with conifers, but due to the intense vegetative competition resulting from resprouting and germinating grasses and brush species, less than 2,000 acres have been planted so far.

The Final Environmental Impact Statement (FEIS) for Vegetation Management for Reforestation in the Pacific Southwest Region was signed by the Regional Forester on February 13, 1989. It allows local land managers to consider a wide range of tools to establish conifer plantations and ensure their growth. Among these are manual and mechanical techniques, controlled burning, and ground and aerial application of herbicides. With these tools now available, the Stanislaus National Forest is beginning five seperate environmental analyses, covering five different geographic areas, to study options to complete the job that has just begun. In addition to reforestation of burned areas, the analyses will include nearby units from recently completed timber sales also in need of reforestation. Due to the size and complexity of these study areas, Notices of Intent to prepare Environmental Impact Statements (EIS's) are being published in the Federal Register for the five analyses.

The five separate analysis areas, with Ranger District responsibility and approximate treatment acreage, are listed here. A map is attached to show their locations.

Paper (Mi-Wok Ranger District) 15,000 acres
Jawbone (Mi-Wok Ranger District) 15,000 acres
Hamm-Hasloe (Groveland Ranger District) 21,000 acres
Larson (Groveland Ranger District) 27,000 acres
Big Creek (Groveland Ranger District) 11,000 acres

We invite you to participate in this process. We will be depending on the FEIS for Vegetation Management for Reforestation for many of the estimates made to characterize the effects of alternative treatment strategies. Our analysis efforts will focus on the site specific aspects of the project areas, and will take into account the combined effects of treating major segments of entire watersheds. New information will also be used as it is made available to us.

We welcome your comments and suggestions as we begin the analysis, especially in helping us identify issues and opportunities specific to the project areas. The Regional Forester's FEIS for Vegetation Management for Reforestation gives us a sound basis to start with, and many of the issues dealt with in that analysis will not have to be re-analyzed at this level. We also welcome your thoughts on alternative approaches to accomplishing the reforestation effort.

Please send your comments regarding the individual analysis areas (three on the Groveland Ranger District and two on the Mi-Wok Ranger District) to the District Ranger responsible for the analysis. To be most useful, comments should be sent by September 25, 1989.

Again, we invite your participation and look forward to the successful reforestation of the 60,000 acres destroyed just two seasons ago.

_/s/_C_Perlee____________

Christopher Perlee
District Ranger
Groveland Ranger District
Star Route Box 75G
Groveland, CA 95321

_/s/_Gerald_J._Kowalski_____

Gerald J. Kowalski
District Ranger
Mi-Wok Ranger District
PO Box 100
Mi-Wuk Village, CA 95346

RESPONDENTS TO THE SCOPING PROCESS

The following individuals and organizations responded to the original scoping effort.

* Ms. Dee Bird
* Mr. Marcus Butler
* Ms. Shirley Campell
* David & Linda Conklin
* Mr. Chris Conrad, Fibreboard Corporation
* Ms. Adena Cook, Public Lands Director, Blue Ribbon Coalition Inc.
* Mr. Stuart Cook
* Mr. and Mrs. William and Mary Crook
* Ms. Beverly Dixon
* Mr. Ed Dunkley, California Association of 4WD Clubs Inc.
* Ms. Terry Hoffman
* Mr. George James
* Senator John Garamendi
* Thomas Lealos
* Ms. Sharon Marovich, Sierra Club Secretary, Sierra Club, Tuolumne Group
* Mr. James McKevitt, U.S.D.I. Fish and Wildlife Service, Division of Ecological Services
* Dr. Robin Schaeffer
* Ms. Patricia Schifferle, Regional Director, The Wilderness Society, California/Nevada Regional Office
* Ms. Judith Starr
* Timber Association of California
* Mr. Phil Towle, California Coalition for Alternatives to Pesticides
* William Tower
* TUCARE

SCOPING REPLY LETTER

The following is the text from the reply to letters received during the scoping process, signed by the Mi-Wok District Ranger.

Thank you for your comments regarding proposed reforestation resulting from the 1987 Stanislaus Complex Fire. Reforestation activities may include a wide range of vegetative management methods, including manual and mechanical techniques, controlled burning, grazing, and ground and aerial herbicide applications.

Your comments and suggestions regarding issues, concerns, opportunities, and treatment alternatives for the Environmental Assessment are appreciated. Please feel free to continue your input into what are certainly critical, and sometimes controversial resource management issues on the Stanislaus National Forest.

Sincerely,

Gerald J. Kowalski
DISTRICT RANGER

FIELD MEETING

On July 17, 1990 members of the local environmental community and Forest Service employees participated in a field trip to view the 1987 Paper Fire Complex site on the Mi-Wok District of the Stanislaus National Forest.

District Ranger Gerald Kowalski proposed the meeting to serve as a forum for members of the environmental community to discuss their concerns regarding reforestation of the burn. Items of concern are categorized by subject area below.

These are a record of the related questions and concerns of the environmental community. These were passed on to the Interdisciplinary Team (I.D. Team) to provide public input in formulating the District's reforestation plan. Participants included:

Gerald Kowalski	Mi-Wok District Ranger
Steve Robertson	Mi-Wok District Resource Officer
Joseph Sherlock	Mi-Wok District Silviculturist
Phyllis Ashmead	Mi-Wok District Information Specialist
Pat Kaunert	Supervisors Office-Public Affairs
Carolyn Hinshaw	Sierra Club
Dee Bird	Central Sierra Greens
Glenda Edwards	Sierra Club
John Buckley	Various Affiliations
Tom Harrington	Sierra Club
Robin Wood	Audubon Society
Jim Herrell	Sierra Club
Byron Rudholm	Audubon Society
Jim Maddox	California Department of Fish and Game

Reforestation Questions/Comments

- How big was the fire and how much are you planning to plant?

- In planning for reforestation is there any consideration for present drought conditions?

- Are any efforts being made to replace wildflower species? Sensitive plants species?

- Do you have to remove bear clover for successful reforestation?

- How does fire affect soil fertility?

- Are you considering what lands are going to be the most suitable for reforestation, or are you going to attempt to reforest everything?

- We need to retain hardwood species in the forest.

- Are there plans to look beyond trying to keep up with sustained yield at the expense of biodiverstity?

- The sustained yield program is focusing too much on timber.

Habitat Questions/Comments

- Along the road, thickets that provided habitat and cover for deer, grey fox, and other animals have been "clear cut". We'd like you to retain these areas for wildlife cover and screening.

- Can you leave the standing snags and down logs to provide habitat sites and biomass material?

- There is a need to manage grasslands and plantations to protect wildlife habitat sites, they are getting "trashed"!

- There is a concern that more energy is going in to creating and maintaining plantations, rather than creating/maintaining forest habitat.

Biodiversity Questions/Comments

- We need to restore and maintain natural biodiversity in order to prevent the forest from being turned into a giant plantation.

- I'd like to see a multistoried, diverse forest replanted with berries and herbs, and rare or sensitive plants in order to establish new plant populations and to provide a suitable habitat for wildlife.

Herbicide Questions/Comments

- How are you going to retain the oaks in aerial spraying? Is there an age consideration? For example is a sprouting oak more susceptible to herbicide than a mature tree?

- Is there a cumulative effect of herbicide on desired plant species such as oak? Would there be a higher impact on the plant the second time that it is sprayed with herbicides?

- How long does the active ingredient last in the soil?/in plant tissue?

- How do you prevent herbicides from getting in the water?

- Are herbicides monitored after application?

- Are there guidelines for measuring herbicides?

- Is there any considerations for using earth berm mitigation along streams?

- If you are prohibited from using herbicides are you still going to plant? How much reforestation recovery would you have if you did not use herbicides?

- When you use an herbicide does it effect present soil fertility?/Future soil fertility?

- How do herbicides effect important soil microorganisms?

- There is a strong concern for the unknown health risks potentially associated with herbicides in the environmnent.

Concluding Remarks

- The use of herbicides is an environmental risk not worth taking, aerial application is undiscriminatory. Hand release is the preferred method providing a safer, cleaner environment with greater social benefits.

- We need to be responsible in what we put into our watershed and where we spray herbicides. Many studies have been done which show how far from streams herbicides can be used without contaminating the water. We need to utilize site specific formulas to calculate distances from water sources rather than simply saying it is safe to spray 100ft from the water source.

- In the past, the public has accepted unsafe management practices, because we were told it was safe. (For example DDT use in agriculture). Today we are questioning the information we are being given because we were not told the "truth" in the past.

- The real issue is not in your technical ability to apply herbicides, but your credibility. As an agency, you are not credible to the public.

- The biggest issue is the Forest Service's ability to look at the whole picture. Herbicide is just one issue, you need to look at fish and wildlife habitats, recreation, etc.

- I am hopeful that the Forest Service is taking an interdisciplinary approach to develop a reforestation plan. Too much emphasis has gone towards the timber industry to supply wood products. Changes need to come from consumers in the wood products they use.

- If this were my forest, I would restore and maintain the natural biodiversity. If you are unable to do this, you may be cutting too much timber and you need to reevaluate your program.

- Wood products should remain in this country, not shipped off at "giveaway" prices to other countries who have depleted their own resources.

- Biodiversity is the most important consideration to this Forest. Planting monoculture plantations may not be as valuable in the long run. I am pleased that the Forest Service is looking at planting a variety of tree species. Non-traditional tree species can and should be encouraged for use in construction.

- There should be a better formulation of herbicide application. One county uses the following method of calculating herbicide application which I recommend: 2 1/2 X height of bank plus 100 ft. from the stream. If herbicides are used, every mitigation measure possible should be used to prevent herbicides from entering the water including earth berms along streams.

APPENDIX 7

DEER TELEMETRY STUDY - BASIS FOR THE NEW DEER WINTER RANGE LOCATIONS

In September 1986, the California Department of Fish and Game initiated a Radio Telemetry study to provide specific information regarding the key habitat areas of the Tuolumne Deer Herd. The study was designed to delineate and document the locations of migration routes, holding areas, and summer range fawning areas. The Stanislaus National Forest Land and Management Resource Plan (LMP) indicates that various study proposals were being considered at the time of writing. This Radio Telemetry study is one of those referenced in the Forest Plan (LMP, III-59). It was developed to serve the needs of the USDA Forest Service during the timber sale planning process. This was a stated objective in the Tuolumne Deer Herd Management Plan (Maddox, 1980). The results of this study were intended to form an appendix to this Plan, in addition to being distributed through other Fish and Game publications. To date, the results have not been formally published. However, via personal communications between the State and the Forest, the majority of the results have been released for use. There is no target date for publication at this time.

The study involved the capture, radio collaring, and tagging (ear) of 20 adult does. The trapping occurred, primarily, between November, 1986, and May, 1987. Deer movements were monitored for approximately two years. Monitoring occurred twice per year, during the migration periods. Preliminary reports were to be prepared every six months. Workload pressures reduced this reporting, but four reports were prepared. The final report has not yet been prepared.

The results of the study provide new, previously unavailable, information regarding the movements and apparent preferences of the Tuolumne Deer Herd. This information was not available during the creation of the LMP.

The study provided the State biologists with improved information about use patterns and travel corridors. The newly-defined winter range, incorporated in Alternatives 2 and 3, reflects this improved information. In summary, only some of the previously identified locations, identified by the Forest Plan, were confirmed. The movements and apparent preferences for specific habitats, as indicated by the telemetry work, significantly add to the knowledge base. New locations and numerous migration networks were identified. In addition to the specific sites that were identified, information regarding how deer move through the winter and summer range has been modified. Movements appear to be more complex than previously thought.

As mentioned above, the publishing date of the final report of this study has not yet been set. However, since the majority of data has been shared and subsequently expressed in Alternatives 2 and 3, the results of the work are visible.

APPENDIX 8

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APPENDIX 9 - GLOSSARY

A

APCD
: Air Pollution Control District

ASQ
: See allowable sale quantity.

AUM
: See animal unit month.

acre-foot
: The amount of water or sediment that would cover one acre to a depth of one foot (43,560 cubic feet; 326,000 gallons).

activity
: A work process that is conducted to produce, enhance, or maintain an output or achieve an administrative and/or environmental quality objective.

activity fuels
: Fuels which have been directly generated or altered by management activity.

activity outputs
: The quantifiable goods or services resulting from any management actions taken on the Forest.

administrative site
: A site which exists primarily for general administrative purposes. It normally will include office, warehouse, outside storage, and parking areas.

administrative unit
: All the National Forest system lands for which one Forest Supervisor has responsibility.

affected environment
: The physical, biological, social, and economic environment within which human activity is proposed.

age class
: One of the intervals, usually 10 to 20 years, into which the age range of vegetation is divided for classification or use.

airshed
Basic units in which air quality is managed.

allocation
The assignment of sets of management practices to particular land areas to achieve the goals and objectives of the alternative.

allotment
See range allotment.

allowable sale quantity (ASQ)
The maximum quantity of timber that may be sold from land capable, available, and suitable for timber production for a time period; usually expressed on an average annual basis.

alternative
In Forest planning, a given combination of resource uses and a mix of management practices that achieve a desired management direction, goal, or emphasis.

amenity (amenity value)
Typically used in land management planning to describe those resources for which market values (or proxy values) are not or cannot be established. See also non-market outputs.

analysis areas
An aggregation of like capability areas with sufficiently similar physical, biological, and administrative conditions such that they would probably respond in a like manner to management activities. See also capability areas.

animal unit month (AUM)
The amount of forage required to support a mature cow for one month (Region 5 uses 1000 lbs./month or 26 lbs./day, air dry weight).

artifact
A simple object (such as a tool or ornament) showing early human workmanship or modification.

aspect
The compass direction that the slope of a land surface faces.

available land
Land which has not been legislatively or administratively withdrawn from timber production.

B

BMP's
See Best Management Practices.

background
The view beginning 3-5 miles from the observer and as far into the distance as the eye can detect the presence of objects.

background level (background, natural background level)
The ever-present environmental conditions or effects above which a phenomenon must manifest itself in order to be detected.

backlog
Work done by the Forest Service, such as reforestation, timber stand improvement, slash disposal and land line location, which needs to be completed.

basal area
The cross-sectional area of a stand of trees measured at 4.5 feet above the ground; expressed in square feet.

benefit
The total value of an output or other outcome.

benefit-cost analysis
An analytical approach to making choices on the basis of receiving the greatest benefit for a given cost or producing the required level of benefits at the lowest cost. Also referred to as cost effectiveness analysis when the benefits cannot be quantified in terms of dollars.

benefit-cost ratio
Measure of economic efficiency, computed by dividing total benefits by total costs. Usually both benefits and costs are discounted to present. See also discounting.

best management practices (BMP's)
Management actions which are designed to maintain water quality by preventative rather than corrective means.

biodiversity
See Diversity.

biological control
A method to control insect populations or tree diseases through the use of applied biology.

biological evaluation
An analysis of the effects of a proposed action on any native or desired non-native species, especially with regard to population viability.

biological growth potential
The average net growth attainable in fully stocked natural forest land.

biomass
The total mass (e.g., weight, volume) of living matter in a biological system.

boardfoot
The amount of wood contained in an unfinished board one inch thick, 12 inches long, and 12 inches wide.

broadcast burning
A technique of applying fire to target fuels which ignites all burnable materials over the entire unit being treated.

browse
Leaf and twig growth of shrubs, woody vines and trees available for animal consumption; act of consuming browse.

burning prescription
Written direction stipulating fire environment conditions, techniques, and administrative constraints necessary to achieve specified resource management objectives by use of fire on a given area of land.

C

CEQ
See Council on Environmental Quality.

CFR
Code of Federal Regulations.

CFS
See cubic foot per second.

CWE
See cumulative watershed effects.

canopy
The more or less continuous cover of leaves and branches collectively formed by the crowns of adjacent trees in a stand or forest.

capability
The potential of land to produce resources, and supply goods and services under a set of management practices and at a given level of management intensity. Capability depends upon site conditions such as climate, soils, and geology, as well as the application of management practices, such as silviculture.

capability areas

The smallest unit of land or water used in Forest planning. They are discrete and recognizable units classified primarily according to: physical (soil), administrative, and biological factors. All land within a capability area is homogeneous in ability to produce resource outputs and in production limitations.

capable lands

Those positions of the forest that have an inherent ability to support trees for timber harvest and produce at least 20 cubic feet/acre/year of wood fiber, CMAI.

carrying capacity

The number of organisms of a given species and quality that can survive in, and not cause deterioration of, an ecosystem through the least favorable environmental conditions that occur within a stated interval of time.

closed canopy

A condition that exists when the crowns of the trees in a stand cover 100 percent of the potential open space.

Code of Federal Regulations (CFR)

The listing of various regulations pertaining to management and administration of the National Forest.

commercial species

Tree species suitable for industrial wood products.

commercial thinning

See thinning.

commodity

A resource product with commercial value.

compartment

A division of forest land defined by natural and manmade features usually between 3,000 and 15,000 acres in size used to facilitate timber planning.

confine

To limit fire spread within a predetermined area principally by use of natural or preconstructed barriers of environmental conditions. Suppression action may be minimal and limited to surveillance under appropriate conditions.

conifer

Tree that bears cones and in most cases has needle or scale-like leaves, such as pine, spruce, hemlock, or fir.

constraints

Limitations; actions which cannot be taken or which must be taken.

containment

To surround a fire, and any spot fire therefrom, with control line, as needed, which can reasonably be expected to check the fire's spread under prevailing and predicted conditions. The normal tactic is indirect attack and burn to human-made or natural barriers with little or no mop-up.

control

To complete the control line around a fire, any spot fires therefrom and any interior islands to be saved; burn any unburned area adjacent to the fire side of the control line; and cool down all hot spots that are immediate threats to the control line, until the line can reasonably be expected to hold under foreseeable conditions. The normal tactic is direct attack on the fire, if possible, and mop-up.

core area

See spotted owl core area.

corridor

See travel corridor for wildlife definition.

cost

The price paid or what is given up in order to acquire, produce, accomplish, or maintain anything.

cost effective

Achieving a specified level of outputs under given conditions for the least cost.

cost efficiency

A means of measuring how productive an input is in producing outputs. Measured by present net value in Forest planning.

cover

Vegetation used by wildlife for protection from predators and weather conditions, or in which to reproduce.

cover/forage ratio

The ratio (as a percent) of the amount of land area in cover condition to that area in forage condition.

Council on Environmental Quality (CEQ)

An advisory council to the President established by the National Environmental Policy Act of 1969. It reviews federal programs for their effect on the environment, conducts environmental studies, and advises the President on environmental matters.

critical habitat

Key land areas used by wildlife for forage and reproduction without which a species might suffer loss of population viability or serious decline in numbers.

crown
The upper part of a tree carrying the main branch system and foliage.

cubic foot
A unit of measure referring to wood volume (1 ft. x 1 ft. x 1 ft.)

cubic foot per second (cfs)
Unit measure of streamflow or discharge, equivalent to 449 gallons per minute or about 2 acre-feet per day.

cull log
Logs which are not merchantable due to their high proportion of nonuseable wood.

cultural resources
Cultural resources are the tangible and intangible aspects of cultural systems, living and dead, that are valued by a given culture or contain information about the culture. Cultural resources include, but are not limited to sites, structures, buildings, districts, and objects associated with or representative of people, cultures, and human activities and events.

cumulative watershed effects
All impacts on beneficial uses of water and soil located outside of primary land use sites. They are the additive or synergistic effects of multiple actions within a watershed. Cumulative effects occur as a result of more than one action and the changes may be either enhance or degrade water quality.

D

DBH
See diameter breast high.

DEIS
Draft Environmental Impact Statement

decadence
Refers to decaying or declining tree stands.

dependent communities
Communities whose social, economic, or political life would become discernably different in important respects if outputs from the National Forest were significantly altered.

dependent species
A species for which a habitat element (e.g., snags, vegetative type) is deemed essential for the species to occur regularly or to reproduce.

developed recreation site
Distinctly defined area where facilities are provided for concentrated public use, e.g., campgrounds, picnic areas, boating sites and ski areas.

diameter breast high (DBH)
The diameter of a tree measured 4 feet 6 inches from the ground.

discount rate
The interest rate which is used to reduce costs and benefits occurring in the future to their value in the present. The higher the discount rate, the lower the present value of future benefits and costs. See discounting and present value.

discounted benefit
The present value of future benefits.

discounted cost
The present value of future costs.

discounting
An adjustment made to costs and benefits to compensate for the fact that dollars received or spent in the future have a lower value today than dollars in the present. For example, it would be preferable to receive $100 this year rather than in one year from now because it could be invested at 4 percent simple interest and be worth $104 in one year. Thus, given the choice between receiving benefits worth $100 today or benefits worth $100 one year from today, one would choose to receive it today. Discounting reduces future costs and benefits to reflect that fact and enables comparisons to be made of benefits and costs occurring at different points in time.

dispersed recreation
Outdoor recreation which occurs outside of planned and maintained developed recreational facilities, e.g., scenic driving, hunting, backpacking.

distance zone
One of three categories used in the Visual Management System to divide a view into near and far components. The three categories are (1) foreground, (2) middleground, and (3) back-ground. See individual entries.

diversity
The distribution and abundance of different plant and animal communities and species within an area.

dominant
One main crown class of trees with their tops in the uppermost layers of the canopy.

down log
All or a section of a tree bole which has fallen or been cut down.

E

EA

See Environmental Assessment.

EFSA
See Escaped Fire Situation Analysis.

EIC
See Ending Inventory Constraint.

EIS
See Environmental Impact Statement.

EPA
Environmental Protection Agency.

early forest succession
The plant and animal community that develops immediately following the removal or destruction of the vegetation in an area.

easement
The legal right to use the land of another owner for a precise and definite purpose, such as for access.

ecological status
The degree of similarity between the present plant community and the potential natural community for a site.

ecology
The study of plants and animals in relation to their environment.

economic cost
Total fixed and variable costs for inputs, including costs incurred by other public and private parties, opportunity costs, and cost savings.

economic efficiency
A measure of how efficiently inputs are used to achieve outputs when all costs and benefits can be identified and valued. Usually measured by present net value or benefit-cost ratios.

ecosystem
An association of interactive organisms and their environment, perceived as a single entity.

edge
The area where plant communities meet or where successional stages or vegetative conditions within plant communities come together. See also edge contrast.

edge contrast
A qualitative measure of the difference in structure of two adjacent vegetated areas; for example, "low," "medium," or "high" edge contrast.

electronic sites

Areas designated for the operation of equipment which transmits and receives radio signals, excluding television aerials and antennas.

encumbrance

See title claim.

endangered species

A species of native fish, wildlife, or plants found by the Secretary of Interior to be threatened with extinction because its habitat is threatened with destruction, drastic modification, or severe curtailment, or because of over-exploitation, disease, predation, or other factors; and its survival requires assistance. Protection is established by the Endangered Species Act. See also threatened species.

endemic species

A plant or animal confined to a relatively small geographic area or to an unusual or rare type of habitat.

environmental impact statement (EIS)

A statement of the environmental effects which would be expected to result from proposed alternative management actions.

ephemeral stream

A stream which flows only from storm runoff and receives no contribution to flow from ground water.

equivalent road acres

Equivalent Road Acres (ERA) is a method of categorizing the amount of soil compaction resulting from land management activities in terms of a common base--a compacted road surface. Roads are assigned an ERA value of 1.00 and all other disturbed areas are assigned ERA values that are less than or equal to one. The values are generally less than one as most other management activities do not cause 100 percent of the ground surface to become compacted.

erosion

The detachment and movement of soil from the land surface by wind, water, or gravity.

escaped fire situation analysis (EFSA)

A decision analysis process from which a plan of action to suppress a fire will be developed. The analysis requires development of alternative suppression strategies, and identifies the probable cost and damage associated with each.

even-aged management

Management of forest stands that results in trees of essentially the same age growing together. Cutting methods producing even-aged stands are clearcut, shelterwood, and seed tree.

even-aged stand
A forest stand composed of trees having no or relatively small differences in age.

expanded suppression
The control or containment of wildfires at increased acreage within allowable fire intensity levels and fire control standards.

extensive vs. intensive management
Loose terms generally used to indicate a degree or level of management; for example, intensive timber management refers to all practices or a set of practices necessary to emphasize timber production on land suitable for timber production. Extensive timber management consists of practices necessary to manage timber on land emphasizing other values.

F

FERC
Federal Energy Regulatory Commission

FIL
See Fire Intensity Level

FMZ
See Fire Management Zone

FORPLAN
A linear programming model used for developing and analyzing Forest planning alternatives. Also see linear programming and Appendix B.

FSH
Forest Service Handbook.

FSM
Forest Service Manual.

FY
Fiscal Year.

fawning area
Area used regularly by female deer for delivery and rearing of fawns located at higher elevations for migratory deer.

firebreak
A wide strip of land from which fuels have been removed down to the soil. Used to stop or check fires and to provide access for fire fighting. See also fuelbreak.

fire intensity level (FIL)

An expression of fireline intensity, based on typical flame length of a fire behavior condition, used to reflect differences in difficulty of suppression and fire effects on resource values.

fire management

All activities required for the protection of resources and values from fire, and the use of fire, to meet land management goals and objectives.

fire management zone (FMZ)

A geographically delineated area of common fire management direction and fire behavior characteristics composed of multiple resource management areas.

fire management area

One or more parcels of land with clearly defined boundaries with established fire management direct that is responsive to land and resource management goals and objectives.

fire management direction

Fire management prescriptions and practices and the planned measurable result desired from fire protection. Consisting of acceptable burned acreages (pars) and operating constraints, and prescribed fire objectives that are based on land management goals and objectives.

fire risk

The potential risk of fire, as connected with human activities.

forage

All browse and nonwoody plants used for grazing or harvested for feeding livestock or game animals.

forb

Any nongrass-like plant having little or no woody material on it. A palatable, broad-leaved, flowering herb whose stem, above ground, does not become woody and persistent.

foreground

The portions of a view between the observer and up to 1/4 or 1/2 mile distant.

forest cover type

A classification of forest land referring to a group of timber stands of similar development and species composition. Examples in California include the Douglas-fir, mixed conifer, and the true fir types.

forest land

Land at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use; or, land within the national forest boundary. Lands developed for non-forest use include areas for crops,

improved pasture, residential or administrative areas, improved roads of any width, and adjoining road clearing and powerline clearing of any width.

Forest Service Handbook
The principal source for detailed instructions for performing specialized tasks. Handbooks complement the Forest Service Manual.

Forest Service Manual
Is the principal source of continuing instructions for the conduct of Forest Service programs and activities, and is the basic and ruling component of the directive system. The Manual is also available to interested persons outside the service as a source of information on basic operations in the Forest Service

Forest Supervisor
The official responsible for administering the National Forest system lands in the Forest Service Administrative Unit, which may consist of one or more National Forests, who reports to the Regional Forester.

forest survey site classes
A measure of the maximum capacity of an area to produce timber, measured in cubic feet per acre per year:

Site Class	*Max. Cu. Ft./Ac./Yr.*
1	225 +
2	165-224
3	120-164
4	85-119
5	50-84
6	20-49
7	less than 20

forest type
A term referring to a group of timber stands of similar character, development and species composition due to ecological factors. Examples on the forest are mixed conifer and true fir types.

fuelbreak
A wide strip of land, strategically placed for fighting anticipated fires, where hazardous fuels have been replaced with less burnable fuels (like grass). They divide fire-prone areas into smaller parcels for easier fire control and provide access for fire fighting. See also firebreak.

fuels
Any material capable of sustaining or carrying a forest fire, usually natural material both live and dead.

fuel management

The practice of planning and executing treatment or control of any vegetative material which adversely affects meeting fire management direction based upon resource management goals and objectives.

fuel treatment

The rearrangement or disposal of natural or activity fuels to reduce the fire hazard. Fuels are defined as both living and dead vegetative materials consumed by fire.

fuelwood

Wood cut into short lengths for burning.

furbearer

A term referring to several species formerly trapped for their pelts and currently protected due to low population numbers: fisher, pine marten, red fox and wolverine are included for this forest.

G

game species

See harvest species.

goal

As used in the Forest Service, a concise statement that describes a desired condition to be achieved sometime in the future. It is normally expressed in broad, general terms, and may not have a specific date for completion.

goods and services

Outputs, including on-site uses, produced from forest and rangeland resources.

grass/forb

An early forest successional stage where grasses and forbs are the dominant vegetation on forest sites last only a few years under natural succession and is replaced by shrubs/small trees.

grazing

Consumption of herbage or artificial pasture forage by animals.

grazing allotment

See range allotment.

grazing permittee

An individual who has been granted written permission (a grazing permit) to graze livestock for a specific period on a range allotment.

groundwater

Subsurface water in the part of the ground that is wholly saturated.

guideline

An indication or outline of policy or conduct that is not a mandatory requirement (as opposed to a standard, which is mandatory).

H

habitat

The sum of environmental conditions of a specific place that is occupied by an organism, a population, or a community. In general usage applies to the vegetation species and arrangement needed by a wildlife species to successfully exist and reproduce.

habitat capability

The estimated ability of an area, given existing or predicted habitat conditions, to support wildlife, fish or plant population. It is measured in terms of potential population numbers.

hard snag

A dead tree which has very limited decay in the heartwood and which generally still has large branches and remnants of the bark. The external wood is quite firm and most primary cavity nesting birds cannot excavate into it.

hardwood

A conventional term for the wood of broadleaf trees. On the Forest also used to refer to the common hardwood species, i.e. black oak, interior and canyon live oaks and blue oak.

hazard

The measure of ease of ignition, fire spread potential, and fire suppression difficulty, as influenced by the type, volume, size, distribution, condition, arrangement and location of the fuels.

heliport

An area used by helicopters for landing and takeoff. Generally has supporting facilities and is accessible by road or boat.

helispot

Any designated landing spot for helicopters. It is distinguished from a heliport by lack of supporting facilities.

herbicide
A substance used to inhibit or destroy plant growth.

hiding cover
Vegetation of sufficient size and density to conceal wildlife from view of potential predators.

home range
An area in which an individual animal spends all, or most of, its time and in which its year-round needs for food, cover and reproduction are met.

horizontal diversity
The distribution and abundance of different plant and animal communities across a specified area of land.

I

ICO's
See issues, concerns, and opportunities.

indicator species
See management indicator species.

inholdings
Lands within the proclaimed boundaries of the Forest that are owned by some agency, organization, or individual besides the Forest Service.

initial action
The prompt, preplanned response to a wildlife.

inner gorge
The inherently unstable, steep slope (65% gradient or more), immediately adjacent to a stream or river channel, extending from the channel or recent floodplain to the first significant break in slope (usually 15% or more). The inner gorge is formed by the natural process of shallow mass wastage resulting from geologic uplift and consequent down-cutting of the stream channel by streams.

inputs
Land, labor, and capital required to produce outputs. Inputs are generally represented by activity costs.

instream flow
The volume of surface water in a stream system passing a given point at a given time.

integrated pest management
A process wherein pests, their impacts and management, are considered an integral part of resource management planning and decision making.

intensive timber management
Timber management practices carried out to increase timber yield per acre.

interdisciplinary team (IDT)
A group of individuals with different training who solve a problem or perform a task through frequent interaction so that disciplines can combine to provide new solutions.

intermittent streams
Streams which go dry for a substantial part of the dry season during years of normal precipitation.

intolerance
The inability of a tree to grow satisfactorily in the shade of, and in competition with, other trees.

inversion
A warmer air layer overlapping a colder one because of a rapid heat loss by reradiation from the ground at night. In the San Joaquin Valley, this inversion produces the "tule-fogs" during the winter months, and in urban areas, it traps a significant concentration of pollutants especially during the summer months.

irretrievable commitments
Applies to losses of production or use of renewable natural resources for a period of time. For example, timber production from an area is irretrievably lost during the time an area is used for skiing. If the use is changed, timber production can be resumed. The production lost is irretrievable, but the action is not irreversible.

irreversible commitments
Decisions causing changes which cannot be reversed. Once used, the resource cannot be reinstated, nor can opportunities be recovered. Applies to nonrenewable resources such as minerals and cultural resources.

issues
Refers to the public issues, management concerns and opportunities identified in the scoping process.

K

K-V funds
Funds set aside from timber sale receipts to finance reforestation, wildlife habitat, and other improvements in the timber sale area.

key winter range
The portion of the yearlong range where big game find food and cover during severe winter weather.

L

landform
A natural landscape that exists as a result of wind, water, or geologic activity; e.g., a plain plateau, basin, mountain, etc.

land line location
To locate, survey, mark, and post the boundaries of national forest lands.

land status
The ownership status of lands within the national forest boundaries.

lifestyle
The characteristic way people live, indicated by consumption patterns, work, leisure, expressed values, and other behavior.

litter
The uppermost, slightly decayed layer of organic matter on the forest floor.

long-term effects
Those outcomes that will be significant beyond the RPA planning horizon of 50 years.

M

MBF
Thousand board feet. A measure of lumber volume equal to 1' x 1" x 1000'.

MIS
See Management Indicator Species.

MMBF
Million board feet. A measure of lumber volume equal to 1' x 1" x 1,000,000'.

MMRs
Minimum Management Requirements

management concern
An issue or problem requiring resolution.

management direction
A statement of multiple-use and other goals and objectives, the management prescriptions, and the associated standards and guidelines for attaining them.

management indicator species (MIS)
A particular type of plant or animal whose habitat needs represent the needs of other species and which can be used for management and monitoring. Its presence or absence is a fairly certain sign or symptom that particular environmental conditions are also present or absent.

management practice
A specific action, measure, or treatment.

mass movement
Downslope movement of a portion of the land's surface, i.e., a single landslide or the gradual downhill movement of the whole mass of loose earth material on a slope face.

mast
Nuts, acorns, and similar products of hardwood species, which are consumed by animals.

mature
The stage of tree growth when CMAI (culmination of mean annual increment) occurs. Generally occurs between 70 and 100 years for most conifer species on the forest and generally when the trees are in size class 4.

maximum erosion hazard
An assessment of the relative hazard of the loss of surface soil that would occur in an average year if protective vegetation were removed.

maximum modification
See Visual Quality Objectives.

mean annual increment
The average yearly growth of a tree, calculated by dividing the volume of the tree by its age.

middleground (middle distance)
The space between the foreground and the background in a picture or landscape. The area located from 1/4-1/2 to 3-5 miles from the viewer.

minimum streamflow
A specified level of flow through a channel that must be maintained for biological, physical or other purposes.

mining claims
Those portions of National Forest land held for mining purposes in which the right of exclusive possession of locatable mineral deposits is vested to the locator of a deposit.

mitigation
Actions to avoid, minimize, reduce, eliminate, or rectify the adverse impacts of a management practice.

modification

See Visual Quality Objectives.

mortality

Dead or dying trees resulting from forest fire, insects, diseases, or climatic factors.

multiple use

The management of all renewable surface resources of the National Forests so that they are utilized in the combination that will best meet the needs of the American people.

municipal watershed

The watershed from which the runoff is used for drinking purposes in a city.

N

NEPA

See National Environmental Policy Act.

NFMA

National Forest Management Act.

NFS

National Forest System

National Environmental Policy Act (NEPA)

A 1970 Act of Congress which is our basic national charter for protection of the environment.

National Forest Management Act (NFMA)

A law passed in 1976 as amendments to the Forest and Rangeland Renewable Resources Planning Act that required the preparation of Regional and Forest Plans and the preparation of regulations to guide their development.

National Register of Historic Places

A listing maintained by the U.S. National Park Service of areas which have been designated as historically significant. The Register includes places of local and State significance, as well as those of value to the Nation in general.

natural forest

The condition of a forest environment at any point in time, including it's associated plant and animal communities, which has been reached essentially through the process of natural succession.

natural fuels

Fuels not directly generated or altered by management activity. This includes fuels that have accumulated because of deliberate fire exclusion.

natural integrity
The extent to which long-term ecological processes are intact and operating.

natural opening
A break in the forest canopy; an area of essentially bare soil, grasses, forbs, or shrubs in an area dominated by trees.

natural regeneration
The renewal of a tree crop by natural means, without man's seeding or planting. The new crop is grown from self-sown seed or by vegetative means, such as root suckers, et cetera.

no action alternative
The alternative which continues current management direction.

non-commodity
An intangible output normally associated with a service or opportunity provided to the public (example: nonmotorized recreation.)

nonconsumptive species
Wildlife species not used as food for human consumption, but normally observed, studied, photographed, etc. (as opposed to harvest or consumptive species).

nonconsumptive use
Those uses of resources that do not reduce the supply. For example: Nonconsumptive uses of water include hydroelectric power generation, boating and swimming.

nongame
Species of animals that are not managed as a sport hunting resource. All birds, mammals and fish which are not included in state or federal hunting or fishing regulations fall into this category.

nonmotorized recreation
Recreational opportunities provided without the use of any motorized vehicle. Participation in these activities is accomplished through the use of foot, ski, snowshoe, or horseback travel.

nonpoint source pollution
Pollution occurring at many diffuse locations, as opposed to pollution from a specific site, such as a factory.

notice of intent
Written notice to the affected District Ranger by those who intend to engage in mining activity on the Forest, including prospecting, exploration, mining, and mineral processing activities.

noxious weeds

A plant species that is undesirable; conflicts, restricts, or otherwise causes problems with management objectives.

O

OHV

See Off-Highway Vehicle

obliteration

The act of eliminating the functional characteristics of a road and reestablishment of natural resource production capability by: 1) barricading it against future use; 2) restoring natural slopes where economically feasible; 3) scarifying roadbed where necessary; 4) establishing adequate drainage; and 5) reseeding or replanting.

off-highway vehicle (OHV)

Any motor vehicle designed for operation on lands other than highways. Includes but is not limited to: (1) any motorcycle or motor-driven cycle; (2) any snowmobile or other vehicle designed to travel over snow or ice; (3) any motor vehicle commonly referred to a sand buggy, dune buggy or all-terrain vehicle; and (4) any motor vehicle commonly referred to as a jeep.

old growth

A stand that is past full maturity and showing signs of decadence; the last stage in forest succession. Although the tree age, size, height, or density will vary by timber type, trees are usually 21" or larger DBH and 150 years or older.

opening

An area of land from which timber has been harvested (generally using even-aged management). In Region 5 the maximum size of openings is 60 acres for Douglas fir and 40 acres for all other forest types. An opening is no longer considered an opening when a specified number of trees per acre within a specific forest type and site class have reached 4.5 feet in height.

ORV

Off-Road Vehicle (see Off-Highway Vehicle)

output

A good, service, or on-site use produced from forest and rangeland resources.

overflow capacity

Use of a developed recreation site which exceeds the designed capacity.

overmature timber

Trees that have attained full development, particularly in height, and are declining in vigor, health, and soundness.

overstory

That portion of the trees in a forest which forms the upper or uppermost layer.

P

PA

See Programmatic Agreement.

Pacific Southwest Region

The Region of the Forest Service covering the 17 National Forests within the State of California. This region is referred to as R-5.

partial retention

See Visual Quality Objectives.

particulates

Small particles suspended in the air and generally considered pollutants.

patented mining claim

A patent is a document that conveys a title. When patented, a mining claim becomes private property and is land over which the United States has no property rights, except as may be reserved in the patent. After a mining claim is patented, the owner does not have to comply with requirements of the General Federal Mining Law but is required to meet State regulations.

perennial stream

Streams that maintain surface or sub-surface flows throughout the year during years of normal precipitation.

planned ignitions

A fire started by a deliberate management action.

planning period

One decade. The time interval within the planning horizon that is used to show incremental changes in yields, costs, effects, and benefits.

plantation

A stand of trees resulting from planting or artificially seeding an area.

plant communities

A group of plants that live together in the same environment.

point pollution source

An identifiable source from which pollutants are or may be discharged, e.g., a pipe, ditch, channel, tunnel, conduit, well.

precommercial thinning

See thinning.

preferred alternative

The alternative recommended for implementation as the Forest Plan.

prescribed fire

Intentional use of fire under pre-determined weather and fuel conditions to achieve specific objectives, e.g., dispose of slash, control unwanted vegetation.

prescription (RX)

The set of management practices applied to a specific area to attain specific objectives.

preservation

See Visual Quality Objectives.

pressupression

The planning and preparatory work done before a fire occurs to ensure effective fire suppression action. Includes: 1) recruiting and training fire forces; 2) planning and organizing attack methods; 3) procuring and maintaining fire equipment; and 4) maintaining structural improvements necessary for the fire program.

programmatic agreement (PA)

A document streamlining the Section 106 process.

public issue

A subject or question of widespread public interest relating to management of the National Forest System.

R

RPA

The Forest and Rangeland Renewable Resources Planning Act of 1974. Also refers to the national assessment and recommended program developed every five years to fulfill the requirements of the Act.

RX

See prescription.

range permittee
See grazing permittee.

Ranger District
Administrative subdivisions of the Forest supervised by a District Ranger who reports to the Forest Supervisor

raptor
A bird of prey e.g., eagle, hawk, owl.

rare species
One that, although not presently threatened with extinction, is in such small numbers throughout its range that it may be endangered if its environment worsens.

recordation
The process of documenting archaeological sites with a standard form, scaled sketch map, and location map.

recovery species
Federally listed threatened or endangered wildlife and fish species for which an objective has been set to raise the population to a viable level.

reforestation
Reestablishing a crop of trees on forest land by natural or artificial methods.

reforestation backlog
Suitable timber land which is currently not stocked with commercial tree species. Lands occupied mainly with hardwoods, brush, or grasses scheduled for conversion to commercial conifers through reforestation.

regeneration
Reestablishing a crop of trees on forest land by natural or artificial methods.

region
An administrative unit within the National Forest system. Each region has a headquarters office and is supervised by a Regional Forester. The Pacific Southwest Region (R-5) headquarters are in San Francisco.

Regional Forester
The official responsible for administering a single Forest Service Region.

Regional Guide
The guide developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended, that guides all natural resource management activities and establishes management standards and guidelines for the National Forest System lands of a given region. It also assigns RPA objectives to the Forests within that Region.

Regional land and management plan

The plan developed to meet the requirements of the Forest and Rangeland Renewable Resources Planning Act of 1974, as amended, that guides all natural resource management activities and establishes management standards and guidelines for the National Forest System lands of a given region.

release

Freeing a tree or group of trees from immediate competition by eliminating growth that is overtopping or closely surrounding them.

residual stand

The trees remaining after some form of selection cutting is performed on a stand.

restoration

retention

See Visual Quality Objectives.

revegetation

The reestablishment and development of a cover crop.

right-of-way

An accurately located land area within which a user may conduct operations approved or granted by the landowner. May also refer to a permit, easement, lease, license, or Memorandum of Understanding (MOU) used to authorize the land use.

riparian area

Land situated along the bank of a stream or other body of water and directly influenced by the presence of water, e.g., streamsides, lake shores, etc. In the Forest Plan, a designated area along streams, defined by some width, to be managed primarily for riparian-dependent resources.

riparian vegetation

All classes of vegetation, trees, shrubs or herbs, dependent on the presence of water in an adjacent stream or lake for their existence on the site.

roadless area

As defined by the Roadless Area Review, an area of undeveloped Federal land within which there are no improved roads or roads maintained for use by motorized vehicles; generally 5,000 acres or larger unless adjacent to an existing Wilderness.

rotation

The length of time between the formation or regeneration of a tree stand and its final cutting.

S

SMZ

See Streamside Management Zone.

SOHA

See Spotted Owl Habitat Area.

scoping process

Process used to identify issues and concerns which are within Forest Service authority to resolve. See also Appendix A.

second growth

Forest growth that has become established after some interference with the previous forest crop (e.g., cutting, serious fire, or insect attack).

secondary range

See range.

sedimentation

The deposition of detached soil and rock material transported by or suspended in water.

semi-primitive motorized

See Recreation Opportunity Spectrum

semi-primitive non-motorized

See Recreation Opportunity Spectrum

sensitive species

Species which have appeared in the Federal Register as proposed additions to the endangered or threatened species list; those which are on an official State list or are recognized by the Regional Forester to need special management in order to prevent them from becoming endangered or threatened.

sensitivity level

A particular degree or measure of viewer interest in the scenic qualities of the landscape.

seral stage

A biological community that is a developmental, transitory stage in an ecological succession. The following vegetative-timber type seral (successional) stages are used to analyze vegetation of the Forest:

1 = Grass/forb stage consisting of annual and perennial grasses and forbs, with or without scattered shrubs and seedlings.

2 = Shrub/seedling/sapling stage consisting of mixed or pure stands up to 20 feet in height.

3A = Pole/medium tree stage including large trees in the size range 20 to 50 feet in height. Total tree canopy cover is from 0 to 29 percent. Stands commonly support a substantial shrub layer.

3B&C = Pole/medium tree stage including large trees in the size range 20 to 50 feet in height. Total tree canopy cover is 40 percent or greater. Shrub layer is variable.

4A = Large tree stage corresponding roughly to a mature and overmature classification. Trees generally exceed 50 feet in height, except perhaps some of the oak trees at lower elevations. Total tree canopy cover is from 0 to 39 percent. Stands commonly support a substantial shrub layer.

4B&C = Large tree stage corresponding roughly to a mature and overmature classification. Trees generally exceed 50 feet in height, except perhaps some of the oak types at lower elevations. Total tree canopy cover is 40 percent or greater. Shrub layer is variable.

5 = The specific component of the large tree stage that is older and overmature with a total canopy cover of 70 percent or greater. The stands should show evidence of decadence.

silviculture

Generally, the science and art of cultivating forest tree crops.

silviculture system

The entire process by which forest stands are tended, harvested, and replaced. It includes all cultural practices performed during the life of the stand such as regeneration cutting, fertilization,
thinning, improvement cutting, and use of genetically improved sources of tree seeds and seedlings to obtain multiple resource benefits. Silvicultural systems are classified as even or uneven-aged.

site index

A numerical evaluation of the quality of land for plant productivity, especially used in forest land where it is determined by the rate of growth in height on one or more of the tree species.

site preparation

The preparation of an area for regeneration. It involves the removal of slash and/or competing vegetation and usually the exposure of bare mineral soil.

slash

The residue left on the ground after timber cutting, or after storms, fire, etc. It includes unutilized logs, uprooted stumps, broken stems, branches, twigs, leaves, bark, and chips.

snag
: A standing dead tree. For the purpose of the Forest Plan it includes broken trees which are at least 20 feet high.

social category
: People with a common social characteristic such as age, nationality, occupation, hobby, interest, or educational level.

social group
: People who cooperate to pursue common interests and/or attain mutual goals.

social impact
: Changes in social or cultural conditions that directly or indirectly result from a Forest Service program, project, or activity.

social organization
: The structure of a society described in terms of roles, relationships, norms, institutions, and/or community cohesiveness and stability.

social value
: A shared standard of preference or desirability, as wealth, beauty, good health, honesty, or privacy.

social variable
: A social or cultural element such as population size, employment, opinion on an issue, crime rates, satisfaction with community life or recreation-use patterns, that can be evaluated at different times or places to show the effects of a Forest Service action.

soft snag
: A standing dead tree from which the leaves and most of the branches have fallen and which has advanced decay in the heartwood and sapwood.

softwoods
: Pertaining to conifer trees. See also Conifer.

soil horizons
: Layers of the soil each of which has comparatively uniform characteristics different from adjacent layers.

soil productivity
: The natural capacity of a soil to produce a specified plant or sequence of plants under a specified system of management.

soil resource inventory
: The systematic examination, description, classification and mapping of soil.

special use permit
: A permit authorizing the occupancy and use of National Forest land in the manner specified.

Spotted Owl Habitat Area (SOHA)
Between 1,650 and 2,650 acres of spotted owl habitat, located within a 1.5 mile radius area. A SOHA is composed of 1,000 acres of base habitat plus additional replacement habitat.

spotted owl network
The network is the distribution of designated spotted owl habitat areas through the known range of the species that allows for continued dispersion and random interchange between members of the population. The network consists of groups of three or more spotted owl habitat areas, separated by not more than 1.5 miles between areas within a group of three. The groups of three are spaced between 6 and 12 miles apart. Areas which cannot be groups (due to natural geographic conditions) are not more than 6 miles from adjacent groups of habitat areas.

stand
A community of trees or other vegetation which is sufficiently uniform in composition, constitution, age, spatial arrangement, or condition to be distinguishable from adjacent communities and to thus form a management entity.

stocking level
The degree to which land is occupied by trees, measured by basal area and/or number of trees by size and spacing, compared with a stocking standard which establishes the stocking required to utilize fully the growth potential of the land.

stream class
A classification given to all named drainages or stream channels on the Forest, based on stream size, season, amount of flow, importance as a fishery or water source, and other characteristics. They range from Class I (largest, most important) to Class IV (small, often intermittent).

streamside management zone (SMZ)
An area of land extending beyond the riparian area commonly managed with caution as a buffer to protect riparian areas and water quality.

subculture
A distinctive pattern of beliefs, values, norms, and customs shared by a portion of the population, often because of a common ethnic heritage, occupation, or religious or ideological orientation.

succession
The gradual supplanting of one plant community by another as the site changes over time until the climax community is reached. See seral stage.

suitable lands
Acres of land selected for management of timber production on a regulated basis from land which has been identified as tentatively suitable. Thus, it is land which meets criteria a. through e. of the tentatively suitable definition and which is to be managed for timber production.

suppression
Actions taken to extinguish or confine a fire.

sustained yield
See long-term sustained yield.

T

T & E Species
Threatened and Endangered species.

TSI
See Timber Stand Improvement.

target
A statement used to express planned results to be reached within a stated time period.

temporary road
A road that will be physically obliterated and seeded after its primary use is completed (i.e., spur road for logging).

territory
An area within a habitat that is occupied by an individual or group and is defended against other individuals or groups of the same species.

thermal cover
Trees of at least sapling size of sufficient density to provide shelter from winter winds for wildlife.

thinning
Cutting timber to improve the quality and growth of the trees that remain. In commercial thinning, merchantable timber, i.e., timber of salable quality, is cut. In precommercial thinning, nonmerchantable trees are cut.

threatened species
Any species which is likely to become an endangered species within the foreseeable future and which has been designated in the Federal Register as a threatened species.

tiering
Refers to the practice of covering general matters in broader environmental impact statements which are subsequently incorporated by reference into narrower environmental impact statements or environmental analyses, allowing them to concentrate solely on the issues relevant to a specific project.

timber
a general term for the major woody growth of vegetation in a forest area.

timber base
The lands within the forest capable, available, and suitable for timber production.

timber production
The growing, tending, harvesting, and regeneration of regulated crops of trees to be cut into logs and bolts for industrial or consumer use. Does not include fuelwood.

timber stand improvement (TSI)
The use of noncommercial thinning, cleaning, weeding and intermediate cuttings to eliminate or suppress less desirable vegetation and improve composition, condition, structure, or growth of a stand.

trail
A general term denoting a way for purposes of travel by foot, stock, or trail vehicle having a width less than 40 inches.

transitory range
See Range

travel corridor
A designated strip to allow for movement of wildlife between reproductive areas or population centers.

treatment plan
A document which allows standard approaches to mitigating effects to classes of archaeological sites or historic structures.

type conversion
The conversion of one type of vegetation cover to another, e.g., forested to nonforested; one tree species to another.

U

USC
United States Code.

underburning
Broadcast burning under a canopy of timber (normally at moderate to low fire intensity levels; flame heights and vegetation scorch designed to be within acceptable resource management limits).

understory
Low-growing vegetation (herbaceous, brush or reproduction) growing under a stand of trees. Also, that portion of trees in a forest stand below the overstory.

uneven-aged management

Management of forest stands which results in trees of several or many ages growing together. Cutting methods producing uneven-aged stands are single-tree and group selection.

unplanned ignition

A fire started at random by either natural or human causes, or a deliberate incendiary fire.

unsuitable lands

Refers to land which is not suited for timber production according to the following criteria defined in NFMA Regulations, 36 CFR 219.14:

a. is not at least 10 percent occupied by forest trees of any size or formerly having had such tree cover and not currently developed for non-forest use

b. there is not reasonable assurance that such lands can be adequately restocked within 5 years after final harvest

c. technology is not available to ensure timber production from the land without irreversible resource damage to soils productivity or watersheds

d. land has been withdrawn from timber production for Congress, the Secretary of Agriculture or the Chief of the Forest Service

V

VAC

See Visual Absorption Capability

VQO

See Visual Quality Objectives.

variety class

A classification system with three visual landscape categories:

1. Distinctive (Variety Class A)--Unusual and/or outstanding landscape variety that stands out from the common features in the landscape.

2. Common (Variety Class B)--Prevalent, usual, or widespread landscape variety; also refers to ordinary or undistinguished visual variety.

3. Minimal (Variety Class C)--Little or no visual variety in the landscape; monotonous or below average compared to the common features in the landscape.

vertical diversity

The distribution and abundance of different plant and animal communities from the ground level up. Especially pertains to the number of levels of shrub and tree crowns in a particular stand.

viable population

A population that is self-sustaining with minimum demographic or genetic intervention over the long-term.

viewshed

The landscape seen or potentially seen from all or a logical part of a travel route, use area, or water body.

visual quality objectives (VQO)

A set of measurable maximum levels of future alteration of a characteristic landscape. These levels are:

1. Preservation--Ecological change only.

2. Retention--Human activities are not evident to the casual Forest visitor.

3. Partial Retention--Human activity may be evident but must remain subordinate to the characteristic landscape.

4. Modification--Human activity may dominate the characteristic landscape but must, at the same time, follow naturally established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middleground.

5. Maximum Modification--Human activity may dominate the characteristic landscape but should appear as a natural occurrence when viewed as background.

visual resource

The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for visitors.

W

WFHR

See Wildlife and Fish Habitat Relationships.

WFUD

See Wildlife and Fish User Day.

water chance

An area generally on a perennial stream utilized for drafting water to accomplish dust abatement on logging roads or used for fire suppression. Water chances can be either a temporary or a permanent water-holding structure.

water influence zone
Areas oriented to outdoor water recreation.

water rights
The legal right to use water.

watershed
The entire area that contributes water to a drainage system or stream.

water yield
The total amount of water coming from an area of land, commonly a watershed, over a given period of time.

wildfire
An unplanned fire requiring suppression action.

Wildlife and Fish Habitat Relationships (WFHR)
A system for organizing information about wildlife and fish species, their habitats, and relationships between them which is used in land and resource management planning to set standards and guidelines, evaluate species and habitat diversity, identify special habitat needs, etc.

wildlife and fish user day (WFUD)
Twelve hours of recreation use oriented to wildlife and fish.

wild trout stream
As designated by the State of California, a stream with a self-sustaining native trout fishery offering outstanding recreational fishing opportunities.

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